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## *The Sales Tax Problems of the General and Sub-Contractor*

The Association of Canadian Building and Construction Industries makes the following announcement through the secretary, Mr. J. C. Reilly:

Considerable difference of opinion has arisen among some of our members in the interpretation of the sales tax regulations, involving the exact status of certain sub-contractors who are also manufacturers.

Certain sub-contractors for steel, architectural iron, marble, elevators, etc., who have taken sub-contracts to supply and erect their materials have billed the general contractors with sales tax on the estimated selling price of the material manufactured by them and which they were installing in the building.

General contractors dispute the right of the sub-contractor to add the sales tax when billing the amount of his sub-contract. Where material only happened to be supplied by the same firm, to be installed by the general contractors, no misunderstanding has arisen, and of course, a sales tax has been added and paid.

Our service letter No. 22, which accompanies this gives the ruling of the Department of Customs and Excise, on such manufacturers operating as contractors or sub-contractors. It is stated that under the provision of the law as it stands, the department have no option in the matter, but to continue to regard manufacturers who erect their materials into buildings as subject to the provisions of the act.

In view of the misunderstanding which has arisen resulting in disputes as to payment, we believe that such cases will be dealt with on their merits if placed before the Department of Customs and Excise. We shall be pleased to render this service to our members, and others engaged in the industry, if particulars are forwarded to us.

In the future, we recommend that all sub-contractors and trade contractors, when giving tenders either to general contractors or to owners, should state specifically whether the tender includes the allowance for sales tax or not. If same is not included, the estimated selling price of the materials to be manufactured, and the estimated tax payable, should be stated. The general contractor will then be able to include this in his bid.

It would, however, greatly simplify the whole question if those manufacturers who become trade or sub-contractors would estimate the tax, and include it in their tender, and specifically state this when giving their bid.

Re-sales tax on lumber, it is important to note that there it no tax payable on lumber when purchased from a wholesaler or retailer, who is not the manufacturer of said lumber. The manufacturer of lumber is the man who takes the logs and converts them into dimensioned timber for building materials, and there is no further tax payable on re-sales after leaving the manufacturers' hands.

* * *

The members' service letter referred to is as follows:

The changes in the sales tax which came into effect May 10th, 1921, do not alter the status of contractors and sub-contractors as previously given. "While technically manufacturers, building and other similar contractors and sub-contractors are regarded as retailers."

The Department of Customs and Excise has ruled, however, that firms classified by them as manufacturers, even though they may also operate as contractors and sub-contractors, must be regarded as manufacturers in respect to goods of their manufacture. They are held responsible for the collection of sales tax from their customers, on the selling price of their manufactured product.

Such firms may, if they wish, segregate the manufacturing section of their business from the contracting section. The manufacturing section will then collect sales tax from the contracting section, based on the same prices as if the sale were made to the retail trade.

Sales Tax changes to be noted are:

**(1) On Sales and Deliveries by Canadian Manufacturers or Producers, and Wholesalers or Jobbers,**
- (a) An excise tax of one and one-half per cent. (1½%);
- (b) A tax of two and one-half per cent. (2½%) on the duty paid value of goods imported.

**(2) On Goods Imported by Retailers or Consumers,**
- (a) Excise tax of four per cent. (4%), payable on the duty paid value.

**(3) On Sales by Manufacturers to Retailers or Consumers,**
- (a) Excise tax payable shall be three per cent. (3%);

**(4) In Respect to Lumber,**
- (a) A tax of three per cent. (3%) on importations;
- (b) An excise tax of two per cent (2%) shall be imposed on sales and deliveries by the Canadian manufacturer. No further excise tax shall be payable on lumber re-sales.

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# The Water Power Resourses of Canada

## A Re-analysis of Available and Developed Powers Places Resourses in More Favorable Light—Estimates of Future Development—Principles of True Conservation

By J. B. Challies, Director of the Water Power Branch, Department of the Interior, Ottawa

During the past two years there has been under way in the Dominion Water Power Branch a careful re-analysis and computation of Canada's water power resources. All existing stream flow and power data available from Dominion and Provincial sources, have been systematically collated, analysed and co-ordinated with a view to preparing on a uniform basis from coast to coast, revised estimates of the power available. While the analysis is not yet finally completed, sufficient progress has been made to warrant the publication of the figures given herein.

The total available and developed power resources are presented in a manner not heretofore adopted. A consideration of the figures will indicate that they place the water power resources of the Dominion in a much more favourable light than have previously published compilations.

While the resources have been exhaustively analysed in so far as the information available will permit, is should be kept in mind that only very meagre data is to hand in many districts and for many rivers.

### Basis of Computation.

The figures listed in the accompanying table and diagram are based upon rapids, falls and power sites of which the actual existent drop or the head possible of concentration, is definitely known or at least well established. Innumerable rapids and falls of greater or lesser power capacity are scattered on rivers and streams from coast to coast which are not as yet recorded, and which will only become available for tabulation as more detailed survey work is undertaken and completed. This is particularly true in the more unexplored northern districts. Nor is any consideration given to the power concentrations, which are feasible on rivers and streams of gradual gradient, where economic heads may be created by the construction of power dams, excepting only at such points as definite studies have been carried out and the results made matters of record.

In brief, the figures hereunder are based on definite rapids, falls and power sites, and may be said to represent the minimum water power possibilities of the Dominion.

The power estimates have been calculated on the basis of 24-hour power at 80% efficiency on the basis of "Ordinary Minimum Flow" and "Estimated Flow for Maxmum Development." The "Ordinary Minimum Flow" is based on the averages of the minimum flow for the lowest two consecutive seven day periods in each year, over the period for which records are available. The "Estimated Flow for Maximum Development" is based upon the continuous power indicated by the flow of the stream for six months in the year. The actual method to determine this flow is to arrange the months of each year according to the day of the lowest flow in each. The lowest of the six high months is taken as the basic month. The average flow of the lowest seven consecutive days in this month determines the maximum for that year. The average of such maximum figures for all years in the period for which data are available is the estimated maximum used in the calculation.

This estimated maximum development is based upon the assumption that it is good commerical practice to develop wheel installation up to an amount, the continuance of which can be assured during six months of the year, on the assumption that the deficiency in power during the remainder of the year can be profitably provided from storage or by the installation of fuel power plants as auxiliaries The correctness or otherwse of this assumption for any particualr site can ony be definitely settled by the careful consideration of all circumstances and conditions pertinent to its development. The method, however, enables us to make a fairly satisfactory overall estimate of the maximum hydraulic power available, as distinctive from the estimated ordinary minimum power available.

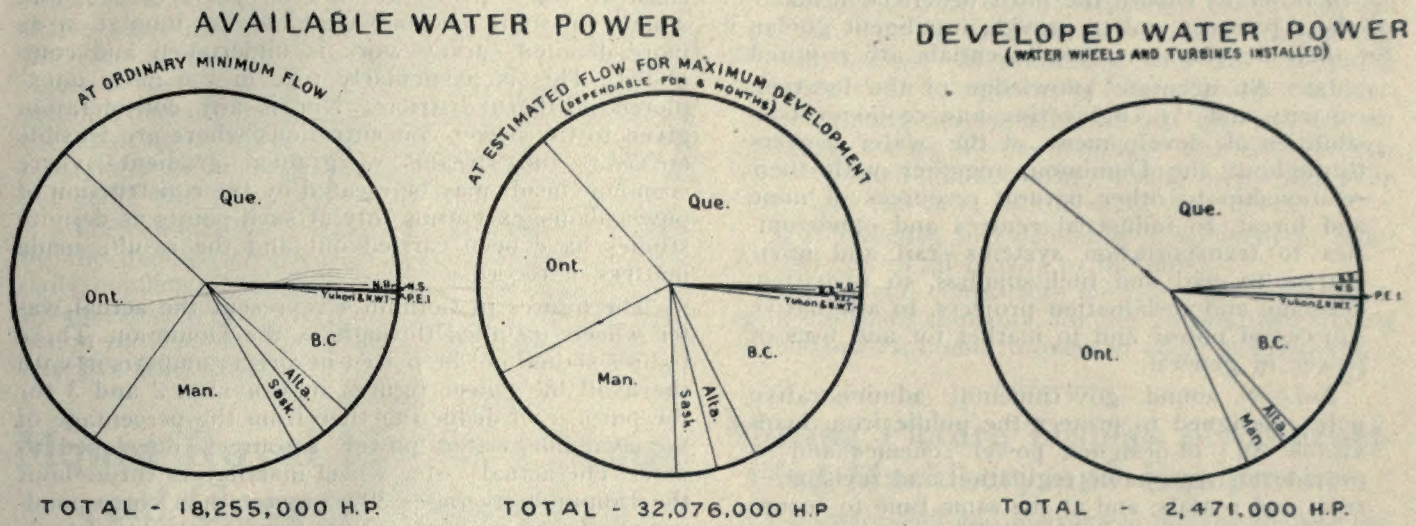
### Available and Developed Totals.

The recorded power available throughout the Dominion, under conditions of ordinary minimum flow and within the limitations set out in the foregoing, is 18,255,000 h.p. The water power available under estimated flow for maximum development, i. e., dependable for at least six months of the year is 32,076,000 h.p. (For details see table attached)

There are installed throughout the Dominion water wheels and turbines to the extent of 2,471,000 h. p. However, it would not be correct to place this figure in direct comparison with the minimum or maximum available power figures quoted above and therefrom deduce the percentage of the available water power resources developed to date. An allowance must be made for the average ratio between the water wheels installed and the power available.

An analysis of the water power plants scattered from coast to coast, concerning which complete information is available as to turbine installation and satisfactory information as to stream flow, gives an average machine installation 30% greater than the six month flow maximum power. Applying this, the figures quoted above therefore indicate that at present recorded water power resources of the Dominion will permit of a turbine installation of 41,700,000 h. p. In other words the present turbine installation represents only 5.9 per cent. of the present recorded water power resources.

In spite of the outstanding facts that financial and

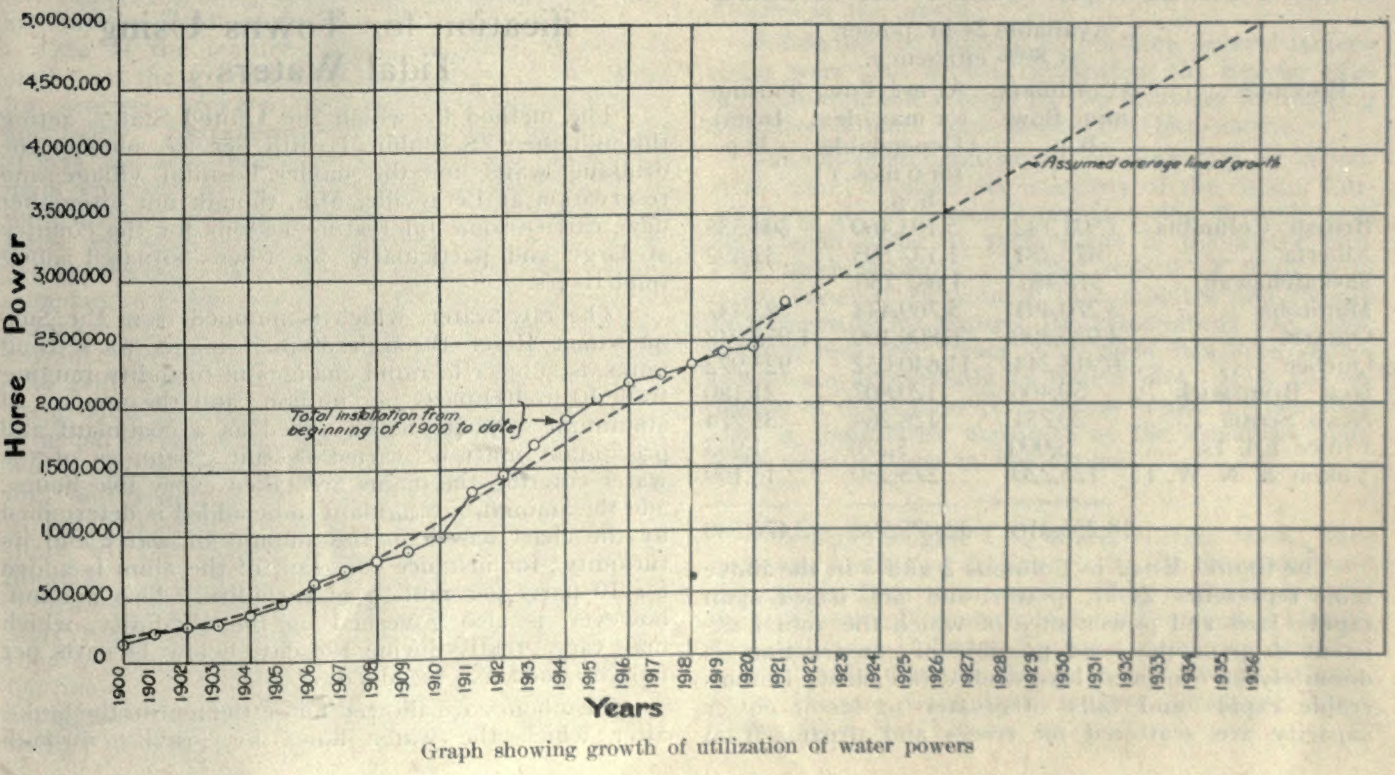


Available water power in Canada on basis of 24 hour power at 80 per cent. efficiency

commercial conditions are still far from normal and that costs of construction are almost prohibitive for all but absolutely necessary undertakings, there has been during the past year and is now, marked activity in hydro construction. This has resulted from a variety of causes principal among which is the lack of native coal in the central industrial district and the fortunate location of economic water power sites to industrial centres.

The total hydro power development installed during the past year or now under construction represents approximately 560,000 h.p. of installed capacity. This figure includes only the initial installations of plants under construction, not their ultimate designed capacity. It is evidence of the manner in which the water power resources of the Dominion are being put to effective and productive use.

It is profitable to consider the history of water power utilization in Canada during the past few years in conjunction with the present activity with a view to making some reasonable forecast as to its probable future growth. Should the rate of water wheel installation during the past fifteen years be maintained there will be installed in 1925, 3,360,000 h.p.; in 1930, 4,110,000; in 1935, 4,860,000 h.p. and in 1940, 5,600,000 horse power. In view of the increasing appreciation of the advantages of hydro power combined with the fortunate location of ample supplies within easy transmission distance of practically every great industrial centre throughout the Dominion, there is every reason to anticipate that the rate of growth in utilization will be accelerated rather than retarded. Reference to the foregoing totals of water power available will indicate that this anticipated increase in utilization will not seriously reduce the total reserves. Canada possesses sufficient reserves of water power to meet all anticipated demands for many years to come.



Graph showing growth of utilization of water powers

In order to ensure the most beneficial utilization of these reserves and to provide intelligent guidance for their development, two essentials are required.

1st.—An accurate knowledge of the location, capacity and the engineering and economic possibilities of development of the water powers throughout the Dominion, together with their relationship to other natural resources of mine and forest, to industrial centres and opportunities to transportation systems—rail and navigation, to coal and fuel supplies, to irrigation drainage and reclamation projects, to alternative sources of power and to market for and uses of power in general.

2nd.—A sound governmental administrative policy designed to protect the public from inadvisable and ill-designed power schemes and to provide for reasonable regulation and revision of rates and rentals, and at the same time to ensure satisfactory guarantees for the encouragement of legitimate investment in hydro power enterprises.

True conservation of our water power resources, which are inexhaustible through use, lies, not in withholding them from development, but in their efficient utilization in the public interest for the economic exploitation of our other natural resources, and for the conservation of our exhaustible fuel supplies.

The water power now developed in Canada represents an investment of $475,000,000. In 1940 should the rate of growth in instalation during the past 15 years be continued, this investment will have grown to over $1,000,000,000. The present development represents an annual equivalent of 18,500,000 tons of coal which, valued at $8 per ton, represents $148,000,000 In the year 1940 these annual figures will, with the foregoing assumption, have become 42,000,000 tons and $336,000,000 These figures are striking evidence of the outstanding importance and necessity of an intelligent administrative policy governing the development of our water power resources.

**Available and Developed Water Power in Canada.**

| Province | Available 24-hr. power at 80% efficiency. At ordinary min. flow h. p. | At est. flow for max. dev. (Dependable for 6 mos.) h. p. | Turbine Instal- h. p. |
|---|---|---|---|
| British Columbia . | 1,931,142 | 5,103,460 | 304,535 |
| Alberta .. .. .. .. | 475,281 | 1,137,505 | 32,492 |
| Saskatchewan ... | 513,481 | 1,087,756 | |
| Manitoba .. .. .. | 3,270,491 | 5,769,444 | 83,447 |
| Ontario ... .. .. | 4,950,300 | 6,808,190 | 1,052,048 |
| Quebec .... .. .. | 6,915,244 | 11,640,052 | 925,972 |
| New Brunswick .. | 50,406 | 120,807 | 21,180 |
| Nova Scotia .... . | 20,751 | 128,264 | 35,774 |
| Prince Ed. Is. .... | 3,000 | 5,270 | 1,933 |
| Yukon & N. W. T. | 125,220 | 275,250 | 13,199 |
| | 18,255,316 | 32,075,998 | 2,470,580 |

The figures listed in Columns 2 and 3 in the above table represents 24-hr. power and are based upon rapids falls and power sites of which the actual existent drop or the head possible of construction, is definitely known or at least well established. Innumerable rapids and falls of greater or lesser power capacity are scattered on rivers and streams from coast to coast which are not as yet recorded, and which will only become available for tabulation as more detailed survey work is undertaken and completed. This is particularly true in the more unexplored northern districts. Nor is any consideration given to the power concentrations where are feasible on rivers and streams of gradual gradient where economic heads may be created by the construction of power dams, excepting only at such points as definite studies have been carried out and the results made matters of record.

The figures in Column 4 represent the actual water wheels installed throughout the Dominion. These figures should not be placed in direct comparison with the available power figures in Columns 2 and 3 for the purpose of deducting therefrom the percentage of the available water power resources developed to date. The actual water wheel installation throughout the Dominion averages 30% greater than corresponding maximum available power figures calcutated as in Column 3. The figures quoted above therefore indicate that the **at present recorded water power resources** of the Dominion will permit of a turbine installation of **41,700,000 horse power.** In other words, the present turbine installation represents only **5.9 per cent.** of the present recorded water power resources

The above figures may be said to represent the **minimum water power possibilities** of the Dominion

As illustrative of this the detailed analyses which have been made of the water power resources of the provinces of New Brunswick and Nova Scotia have disclosed most advantageous reservoir facilities for regulaing stream flow and it is estimated that the two provinces possess within their respective borders 200,000 and 300,000 commercial horse power These figures provide for a diversity factor between installed power and consumers' demands.

# An Effective Method of Water Purification for Towns Using Tidal Waters

The method by which the United States. acting through the U.S. Public Health Service. purifies the drinking water for the model hospital village and reservation at Perryville, Md., though not altogether new, carries some interesting lessons for the country at large and particularly for towns situated along tidal rivers.

The raw water, which is pumped from the Susquehanna River through 30-inch mains to settling tanks, is subject to rapid changes in turbidity ranging from 10 to 100 parts per million; and the amount of aluminum sulphate to be added as a coagulant and precipitant must be varied to suit. Samples of the water entering the mains are taken every two hours; and the amount of coagulant to be added is determined by the chart based on the amount of water and its turbidity; for instance 0.6 grain of the alum is added for 10 parts per million of turbidity. This amount, however, is also governed by the alkalinity, which may vary greatly during the day, below 14 parts per million, soda ash is added.

Two hours are allowed for settlement in the tanks, after which the water flows by gravity through mechanical rapid sand filters, passing through three feet of sand and eight inches of stone and gravel at the rate of two inches in 55 seconds. Later, the water is treated with liquid chlorine, the amount depending on bacteriological examination of the raw and the chlorinated water. This treatment reduces the bacteria from an average of 2,630 (maximum 7,860) per cubic centimeter to less than one.

The condition of the water at Perryville is effected by the geological formation of the country, by the daily conflict of the tide and the river current, and by the strong winds which often cause terrific wind action on the low flats, all of which necessitate very effective treatment.

# Mount Royal Hotel in Montreal Goes to Thompson Starrett Company

The contract for the construction of the Mount Royal Hotel, Montreal, has been let to the Thompson Starrett Company, of New York. When completed it will be the largest hotel in that city, and one of the largest on the North American continent. It will occupy the entire block bounded by Peel, Metcalfe, and Burnside Streets, the area being 252 X 209 feet. The construction involves the demolition of the old Protestant High School and the cutting of a new thoroughfare seventy-five feet north of, and parallel to St. Catherine Street West. This will ge known as Mount Royal Place. The entire cost is estimated at $8,000,000.

The plans have been drawn by Ross and Macdonald, architects, Montreal, for the Mount Royal Hotel Company, Limited. The original intention was to erect a sixteen storey building, but the Administrative Commissioners declined to alter the by-laws for this purpose. As now designed, the hotel will be ten storeys high, of fireproof construction, and with an exterior finish of artificial stone.

One of the features will be a large number of stores on the ground floor and a number of offices, for dentists, brokers, etc., on the mezzanine floors and lobby. Entrance to the shops will be from the streets and also from the interior of the hotel. The main entrance to the hotel will be on Peel Street, with another entrance on Mount Royal Place. The latter will give access to the mezzanine floor, where private dining rooms and the executive offices of the company will be located. A special elevator and a staircase will be also provided at the Metcalfe Street entrance for giving access to the mezzanine level. The grill room, barber's shop, and toilets will be on the ground floor, near the Mount Royal entrance. The principal dining room, entered through a palm room, will be on the main floor level; it will be two storeys high and will run almost the entire length of one side of the hotel at the northwest corner. Besides this, there will be a cafe and rooms available for club dinners.

Above the mezzanine floor there will be eight storeys devoted mainly to bedrooms, totalling 1,050 rooms. The corner rooms will be arranged in suites. On five of the floors certain rooms are to be specially equipped for sample rooms. The various public rooms will be furnished in different styles.

On the top floor will be situated a banqueting hall and ball room, in addition to several rooms suitable for conventions. In connection with the banqueting hall, a special kitchen is to be located on the top floor.

The dining service and kitchen are laid on the northeast corner of the building, and will directly serve the main and subsidiary dining rooms, the palm room, and the cafe, on the main floor level.

It is intended to establish a department in order to take care of all repairs to the hotel.

The general contractors have decided to incorporate a Canadian company, for the purpose of carrying out the contract, and to open an office in Montreal.

# Moving Picture Display of Contracting Machinery and Equipment

An interesting and instructive moving picture display, showing the Austin Machinery Corporation's entire line of contracting mochinery in operation on several large contracting projects throughout the United States and other Foreign countries, was presented at the Strand Theatre, Toronto, on Wednesday morning, June 29. A representative of the company was present and explained fully the working of the machines during the showing of the film. Excellent views of the trench diggers, back-fillers, drag-line excavators, wagon-loading machinery, cube mixers and paving plants, and industrial railway equipment were shown. The entire line of machines travel under their own power, can be adapted to steam, electric or gasoline drive and are simple in operation, being almost entirely one-man controlled. The heavier units, such as paving plants, trench diggers, etc., are mounted on caterpillar tractors. During the forty-years of experience in the manufacture of earth moving and concrete mixing equipment, several new time and labor saving devices have been added from time to time, until the company now claim to produce the most comprehensive and up-to-date line of contracting machinery in the world.

Following the running of the film, several lantern slides were also shown, illustrating the heavier type of machine manufactured by the company for digging irrigation ditches and work of a like nature.

The Canadian Linderman Company, Ltd., of Woodstock, Ont., a subsidiary company of the Austin Corporation, are at present manufacturing the self-feeding wagon-loader at their plant in the above city. This machine loads a 5-yard wagon or truck with loose material in from 6 to 8 minutes and though built specially for loading such materials as coal, sand, crushed rock, etc., from stock piles, has been shown to operate successfully in gravel pits. It is the intention of the Austin Corporation to add the manufacture of their other machines at the Canadian plant from time to time in the future.

The Dake Engine Co., Grand Haven, Mich., have issued an attractive catalogue, No. 28, describing and illustrating their equipment. This includes Air and Steam Motors; Pneumatic Hoists; Contractors Hoists; Crane Hoists; Hoisting Engines; Swinging Engines; Motor Crabs; Electric Hoists; Steam Steering Gears; Spud Hoists; Gangplank Hoists; Capstans; Windlasses; Fish Net Lifters, etc.

# Land Subsidence and its Effect

## Causes of Soil Failures—Water Action the Chief Cause of Trouble—Current Practice in the Avoidance of Structural Damage

By Lawson S. White, before the Concrete Institute (British)

It is not the intention of this paper to present new theories nor even to dwell upon any particular incident, but rather to make a general survey of the subject by citing recent examples of failures due to subsidence, and the opinions of engineers as to their cause, and noting in a general way, some of the methods employed either in preventing such failures or in remedying them after their occurrence

The first consideration in designing the foundations of a structure is the bearing capacity of the ground. Efforts have been made to tabulate the various types of bearing surfaces met with, in order to give to each a definite value for calculation. This tabulation could apply only in a very rough sense, since even the description of soils varies with the locality and with the individual view of the engineer. The same material may vary considerably in different parts of the same site, or may present widely different properties as the result of some subsequent reaction

The Geological Survey of Great Britain has recorded invaluable information as to the physical properties of our soils and the relation in which they stand to one another, and a study of the geology of a district is of the greatest assistance in gaining a true appreciation of the conditions to be expected.

For small work the rule of thumb calculation for bearing values is usually all that is required, provided that local conditions are respected, but for heavier work, where large areas are covered and big sums of money expended, more accurate methods, following a thorough investigation, are essential.

### Early Theory and Practice.

It is thought advisable here to make a brief reference to established principles of earth pressures and compare them with conclusions drawn from more recent investigation and theory. One of the earliest theorists to submit a mathematical treatment of earth pressures was Rankine. Obviously, as a pioneer in the subject, he had to assume the simplest conditions possible, and since the general run of earth did not seem to possess the characteristics of a solid, he took as his standard dry sand, in which cohesion was absent and only the latent force of friction was available to keep the mass together and transmit pressures throughout its bulk. Many engineers have since realized the unsatisfactory results which come from applying Rankine's formula to soils of a different character to that of sand, such as clay, &c., and valuable experimental research by Darwin, Wilson, Bell, Crosthwaite and others has shown that cohesion plays an important part in earth pressure.

The uncertain and unstable nature of cohesion in soils forbids a definite classification of cohesive values. In many cases, cohesion is largely attributable to water content, a certain percentage of which gives a maximum cohesive value. Should the water either dry out or increase in quantity—contingencies most certainly are to be expected the cohesive value is quickly changed. If, therefore, a value for cohesion is assigned to a certain soil, due care should be taken that the character of that soil is not influenced by external agencies.

### More Recent Theory and Practice..

Recent investigations have tended to show that earth in foundations behaves somewhat as an elastic solid of low strength and low shearing value. It might therefore be treated as any other structural material, when its relation of stress to strain, or load to settlement, has been ascertained. The elasticity of earth is commonly observed by a slight swelling or rising of ground after a load is released.

A load is considered to be transmitted to the earth over an area which is constantly increasing with its depth from the surface, and the principle of the bulb of pressure indicates the method of transmission of pressure from a load to the surrounding earth. If the bearing power of the soil at the base of a pile group is exceeded, it is obvious that a settement must occur, and this will be arrested only when the bulb of pressure for the whole group has been established in equilibrium.

A soil which has cohesive properties will naturally derive support from the earth in contact with its lateral surfaces. As the area increases the lateral surfaces become relatively smaller in proportion to the area, and consequently a larger unit load can be supported over a smaller area than over a larger one. This fact is frequently overlooked, and soils tested by loading a small area are often thought capable of supporting the same unit load over an unlimited area.

In cases so far dealt with the author assumed a homogeneous soil, or a soil which grows more compact with depth, but instances occur where the existence of underlying strata makes it necessary to change treatment. The problem then becomes rather complex, involving the calculation of stresses in an overlying stratum acting as a plate on a yielding support.

Let us now consider under what conditions the state of the soil contributes to the failure of foundations.

### Coast Erosion.

The sea is one of the most troublesome and relentless agents, and examples of its effects are only too frequent. By constant storm and wave action the coast is worn away and undermined, or by water penetration to clay strata a greasy surface may be formed on which the mass above can slide forward and downward to the sea. Protective measures against wave action, such as groynes and sea-walls are a partial and in many cases a complete cure.

### Local Erosion.

River erosion, either by an alteration in the direction of the flow or by scouring the channel, is chiefly to be expected in countries subject to torrential downpours. Exceptional floods may open up a new course or undermine and destroy existing structures. In regions thus affected a practical method of strengthing soft banks is to plant deep rooted vegetation in the slope. Where a river wall is liable to be undermined by a deepening of the river bed, a flexible mat, consisting of large concrete blocks threaded on wire cable, has effiectively prevented scour.

It often happens in gravel soils that a stream flows beneath the surface. Near a river, where a heavy building is founded on alluvial deposit which covers the ballast bed, the soil may be forced down to a level at which it becomes effiected by the erosive action of the flowing water. In shuch cases it is advisable to take the foundation to ballast.

Careless construction of drains and water mains is a frequent cause of destruction of property in towns. A leakage frequently grows and may wash away the earth in its passage, and thus often couses an ugly settlement where it has access to the foundation bed of a builing. These leakages may sometimes be due to a break caused by a slight natural subsidence or a swelling of clay soils in the wet.

### Subterranean Workings.

In mining districts where careless methods have been employed, subsidence of large areas of land with consequent destruction of property is only to be expected. Instances are quite common in the coalfields where the seam is naer the surface, and they are also very frequent in salt mining districts. The remedy lies in careful backfilling after mining or in the provision of adequate permanent suports. An irrecoverabe waste of valuable fuel is caused by leaving 30 pen cent of the cola seams in pillars to suport the roof.

Chalk as a foundation bed should be well tested, since it is liable to undergo dissolution, leading to the formation of cavities or "pipes" which may cave in under pressure.

### Organic Interuption.

Buildings founded on timber grillages often subside because of the decay of the timber. If the water level changes constantly, and the foundation is subject to alternate wet and dry periods, this decay is rapid: but timber may last wel in earth always saturated with woter. Top soil must be avoided as a foundation for buildings and, if feasible, for embankments, since it is honeycombed with wormholes and root chanels, and it should always be stripped to a sound deapth The subsidence of earth-fills is often due to neglect of stripping. Water usually penetrates to the depression caused by initial subsidence, and so ubricates a surface on which an extensive slide of the embankment may occur.

### Natural Shrinkage of Ground.

Where large tracts of marshy ground, with thick peaty top soil, are drained, a considerable subsidence takes place. This is due to three main causes—drying, decay, and cultivation.

Since a country of this type is usually very flat and almost waterlogged, the drainage system must be very carefully thought out, and provision made for mavimum shrinkage. As the water table is lowered so the grades change, and unless this is allowed for, a pumping plant or drainage system may be rendered useless. Building on slowly subsiding soils usually settle equally and without damage, but he decay of timber pile foundations subsequent to the lowering of the water level is a frequent cause of failure.

### Shrinkage of Earthworks.

It is moot point with engineers whether or not earth taken from a cutting shrinks when made into an embankment. From exhausive investigation of actual works it would appear that in calculating excavation quantities an allowance should be made. It would be difficult to compact earth more closely than nature does, and the density of the soil increases with its depth. Top soils, however, contain a considerabe percentage of voids caused by frost or arganic action; and since most embankment are built of soil of this nature, taken from shallow excavations, it is only to be expcted that, quite apart from apparent shrinkage of volume due to subsidence of foundation bed and loss of voume due to transportation from cut to fill, or else due to rain erosion, a decrease in volume will result from handling and eposition and subsequent pressure in the fill.

Made-up ground takes time to settle finally, in spite of most careful watering and rolling in deposition. "Hydraulicking," a moern method of building large fills by pumping the material into place with water, resembles more closely the natural method of formatioin and produces best results. Unless it is throughly investigated and tested, "made-up" ground should be avoided as a foundation bed for heavy buildings.

### Weather Effects.

Every building foundation should be placed below the frost line, to aviod failure either by upheaval through expansion by frost or by subsidence on account of te weakness of frost-loosened soil.

On works, such as new roads, where very shallow foundations are only practicable, great care must be taken over the drainage of the subgrade. There are instances without number in which a waterlogged subsoil has frozen and caused wholesale bursting up of miles of new roadways.

Clay soils are very sensitive to weather changes, since the swell considerably and contract when dry. This generally acounts for the all too frequent sight of cracked or leaning garden walls an gate piers. To avoid frost and weather action it is advisable to lay foundations, according to local conditions, at from 5 ft. to 8ft. below the surface.

### Alteration of Water Level.

Water, when present in soils at a more or ess constant level, often accounts for a certain amount of the bearing capacity, since it keeps the earth in a swollen condition. A change of bearing capacity is therefore to be expected when the level of the water is altered. The change occurs usually on account of a fall of level, in wich case a natural subsidence follows the shrinkage.

The lowering of the water level may be brought about in many ways, as, forexample, by artificial drainage, by drawing from wells or by pumping, by natural drainae, or rainage to nearby excavations or to deep railway cuts or tunnels in the neihborhood.

When pumping operations are extensive and prolonged, and a flow of water is drawn from adjacent sources, fine particles are often carried away by the current. This continual robing of the subsoil must eventually cause a subsidence of the overlying ground.

The eradication of the evil of wet basements by subsoil drainae often introduces the greater evil of foundation failure.

### Sliding.

The resistance to movement created by friction of soils on soils or structures on soils is the undamental cause of their stability. Many failures of embankments, retaining walls, dock walls, &c., are attributable either to subsequent loss of frictional resistance or to the exceeding of the retistance value in design.

Water is the chief enemy, and, unfortunately, it it is almost impossible in many cases to avoid ts penetration to foundatio beds. Deep, porous, sandy soils drain themselves freely, but clay soon becomes saturated, loses cohesion and frictional resistance, and offers little resistance to the lateral thrust of superimposed soils or structures.

Good drainage is therefore essential where possible. In cases where it is not possible to avoid water penetration foundations must be taken down far enough to ensure their stability under the worst conditions, and lateral thrusts should be relieved or balanced to reduce their efforts to a minimum.

### Flowing of Soil.

When its cohesive strength is exceeded a soil has a tendancy to flow like a plastic mass. In some cases the breaking down of cohesion destroys a resistance that cannot be regained, and movement continues until the pressure is distributed over an area large enough to bear it.

### Landslides.

Excavations for new building in districts already built upon are a constant source of danger and trouble on account of the little attention paid to earth presures, and even when shoring is placed to counteract the thrust of the earth behind, it is often inadequate or removed too soon. A slight settlement may break a sewer or water main, and thus develope into a much more extensive slide.

At first sight there apears to be many varieties of land slides, but on investigation we find that they are mainly attributable to the same cause—naimly water action in addition to lubricating a surface, water will transmit the pressure due to its head on the underside and at the back of the slide and so force it forward. The avoidance or elimination of trouble seems to be achieved by a thorough investigation of the geology of the district before construction is begun and by drainage where necessary.

### Unequal or Excess Loading on Weak Soil.

So far failures due to unforceen or unexpected natural conditions have principally been considered. More often however, the human element is at fault, and this is not to be wondered at when so little definite information is available for the use of designers.

For building on ground of low bearing value spread footing or raft foundations are often used, in which case care must be taken to distribute the load equally, so that subsidence, if any, will take place uniformerly. An unequal settlement will throw the building further towards the overloaded side, and thus cause still greater movement, which, to a structure of considerable height, might prove fatal.

Reinforcement of the "raft" is a stadily growing practice, and has proved successful in many cases. The steel may be placed in the body of the mattress, as slab reinforcement, or, more efficiently, between the column bases in beams or cantilevers formed in trenches of the desired dimensions cut in the foundation bed.

In calculations to determine the bearing area for building the live load must not be neglected. A convenient method of caculation is to consider the footing in which the live load bears the highest proportion to dead load, and to note the area needed to support its total load at the allowable unit-bearing value. From this, neglecting now the live load, we can calculate the dead load per unit area or the footing, and adopt this as the unit for the calculation of areas required for the other footings.

Pile foundations are often abused, and sometimes placed were absolutely useless. A pile driven down to a material of good bearing capacity will sustain its load as a colum, but when a suitable bed is too far distant a pile may be driven for a length into a weak soil, when it will transfer its load by skin friction. By the bulb of pressure it has already been shown that a certain number of piles will load an area to its maximum and extra piles, to be of any service whatever, must be driven outside that area to create a larger zone of resistance. Athough piles will bear a high vertical thrust, they are weak laterally, since they are easily forced through the soil, and serious failures have occured on account of lateral pressure, such as might be expected with a retaining wall. Piles should therefore be driven in the line of resultant pressure.

In soil of a compressible nature it is seldom that a building maintains its original foundation level, but such slight subsidence is not to be feared if it is uniform, and it is a rowing practice to expect a small settlement and make allowance for it. An effort should therefore be made to tie a building well together, and make it act more as a unit than a collection of disjointed parts. Reinforced concrete is by nature an ideal structural material under such circumstances.

### Conclusion.

By this short summary of the various causes of subsidence, the author hopes that attention will be directed to the need for a closer study of the subjct, and that rom this a more confident practic will result.

It is easier to brace an excavation adequately than to be obliged to rebuild a street of ruined houses.

It is more economical to investigate a fountain bed thoroughly and to design sound footings than to underpin weak footings after their failure.

Alowance must be made for any "natural" change of state whicsh might occur, for otherwise a design fo state which might occur, or otherwise a design may prove inadequate to meet new conditions.

Where trouble occurs it is due in a great many instances, to water actioin. Good drainage, therefore, is a key to safety.

It has been said of foundation design that, unlike most other engineering calculations, it pays little heed to a safety factor, but it now seems far more possible that this highly desirable working margin may be economically obtained by the more extensive use of reinforced concrete in foundations.

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A number of prominent American engineers recently attended a conference of the Institution of Civil Engineering to present the John Fritz medal to Sir Robert A. Hadfield, for the invention of manganese steel. The medal is the highest honor awardable by the American engineering profession.

# An Analysis of the Costs of Manufacturing Brick

## The Various Factors Involved in the Cost of Producing Brick in a Stiff-mud Plant—A Study of the General Relation of Operating and Overhead Expenses

By D. S. Gray

THE following is a short description of the actual operation of a brick plant, and an analysis of costs of production. A stiff-mud plant is the type considered.

The clay used is a Medina shale with considerable free-stone. It is mined from an open bank and the freestone which occurs in layers is separated by hand. From the pit, the shale is carried to the plant by means of an overhead cable tramway a distance of a quarter of a mile, and operated by a 10 h.p. electric motor. It is dumped directly in front of two 9 ft. low frame dry pans, each pan having a capacity of 25,000 brick or 50 cu. yds. of shale per day. One 125 h.p. motor supplies the power for the pans.

From the pans the ground shale is elevated and passed over piano-wire screens, which allow the fine material to pass through to a conveyer leading to the pug mill. From the pug mill the plastic material falls directly with the auger of the brick machine, which forces the clay out through the die and over the cutting tables. The automatic cutter cuts the brick and the column passes on to a faster moving belt, thus separating the brick so as they may be lifted and placed on cars. The power necessary for running the pug mill, brick machine, cutter, conveyors, etc., is supplied by a 150 h.p. motor.

The brick are piled 500 to a car and are next dried in a 12-tunnel metallic radiation dryer. The fuel used is coal. After allowing twenty-four hours for drying, the cars are transferred to the kiln, where the brick are removed and set for burning.

While the principles of burning are the same, the number of different types of kilns is legion and to attempt to go into a discussion of the merits of each would be impossible in the present article. It will therefore suffice to describe one type. The brick is burned wtih unscrubbed producer gas. There are four water-sealed producers, three being in continuous service. The clinker is removed every three or four days. There are two batteries of Raymond continuous producer gas fire brick films, nine chambers to each battery. The oxygen necessary for combustion meets the gas in the combustion chamber, the air being pre-heated by passing over brick in various stages of cooling. The brick are burned in 1900 deg. F., and the products of combustion after doing the duty of burning one chamber, are still further used to raise the temperature of four or five other chambers.

The gas burning continues for twenty-four hours in each chamber is then turned over into the next chamber and goes on continuously in this manner. This permits considerable economy, as the brick in the chamber are always preheated before the actual burning of the gas in that particular chamber takes place. In fact, the temperature may be raised to 1400 deg. F. before the gas is turned on. The burning chamber has a blanket of fire on one side of it and there is little difference between the top and the bottom of the kiln. Each chamber is 40 ft. x 16 ft., and 12 ft. high, holding 60,000 brick. Draft is supplied by means of two 5 ft. fans, one electrically driven and one driven by steam. A complete electrical pyrometer system enables the burner to control the temperature at all times.

After cooling, the brick are sorted for quality and color, and placed either directly on cars for shipment or piled in the yard.

### INITIAL COST OF PLANT

| | | |
|---|---|---|
| 1. Land | | $ 10,000.00 |
| 2. Building | $ 9,000.00 | |
| (a) Power house | 9,000.00 | |
| (b) Kiln | 100,000.00 | |
| (c) Fan house | 1,000.00 | |
| (d) Producer house | 9,000.00 | |
| (e) Dryer | 25,000.00 | |
| (f) Factory | 10,000.00 | |
| (g) Machine shop | 1,500.00 | |
| | | $155,500.00 |
| 3. Equipment: | | |
| (a) Steam generated electric power plant | 25,000.00 | |
| (b) Motors | 7,500.00 | |
| (c) Machinery | 25,000.00 | |
| (d) Machine foundations | 1,500.00 | |
| (e) Elevators and conveyors | 8,000.00 | |
| (f) Shafts, pulleys, belts, etc. | 2,500.00 | |
| (g) Gas producing plant | 10,000.00 | |
| (h) Draft system for kiln | 3,000.00 | |
| (i) Tools, etc. | 1,500.00 | |
| (j) Trucks, cars, etc. | 10,000.00 | |
| (k) Wagons, carts, etc. | 500.00 | |
| | | $ 94,500.00 |
| Grand Total | | $260,000.00 |

This represents the initial cost of the stiff mud plant, having a capacity of 50,000 to 60,000 bricks per day, or say 13,000,000 bricks per year.

Proceeding to the consideration of the above statement we will take each item separately and analyze it.

1. Land. This item represents the investment for land and should cover a sufficient acreage to supply raw material for the life of the plant, say 50 years.

2. Buildings.

(a) Power House. This building houses the steam generated electric power plant, and is a one story brick building on concrete foundation having concrete floors and roof with steel beam supports.

(b). Kiln. The kiln is 118 ft. x 185 ft., of practically solid brick construction. Some idea of the size may be deduced from the fact that over 3,000,000 brick were required for construction. This cost also includes the roof over the entire building.

(c) Fan House. This building houses the draft system and also an office for the kiln superintendent.

(d) Producer House. This is a one story concrete foundation and floor, 45 ft. x 71 feet.

(e) Dryer. The dryer is 50 ft. x 103 ft., and contains 12 tunnels. The cost also includes the drying shed and the steel rails in the dryer.

(f) Factory. This building is 65 ft. x 150 ft., and houses all the manufacturing machinery.

(g) Machine Shop. This building is a combination tool room and general repair shop.

3. Equipment.

(a) Steam generator, electric power plant. This includes boilers, heaters, pumps, etc., and a 350 h.p. vertical twin cylinder high speed condensing engine direct connected to a 200 k.b.a. generator, 55 amp., 2300 v., 3 ph. 25 cycles, also all swtichboards, wiring, etc.

(b) Motors. 125 h.p. motor for dry pans, 10 h.p. motor for tramway, 510 h.p. motor for brick machine, and 20 h.p. motor for fans.

(c) Machinery. This amount is made up as follows:—

| | | |
|---|---|---|
| Factory: | | |
| Brick machine | $ 6,000.00 | |
| Pug mill | 4,000.00 | |
| Two dry pans | 10,000.00 | |
| Automatic cutter | 3,500.00 | |
| | | $ 23,500.00 |
| Machine Shop: | | |
| Emery grinder | $ 80.00 | |
| Threading machine | 30.00 | |
| Drill | 300.00 | |
| Shaper | 1,040.00 | |
| Forge | 50.00 | |
| | | $ 1,500.00 |
| | | $ 25,000.00 |

(d) Machine Foundations. The great weight of all machines necessitates very heavy foundations, so these have been included under a separate heading.

(e) Elevators and conveyors. In addition to the necessary carrying machinery, this item includes the cost of the tramway, $4,000.00.

(f) Shafts, pulleys, belts, etc.

(g) Gas producing plant. This item consists of four gas producers, 11 ft. high, 8 ft. in diameter, and all connections up to the kiln.

(h) Draft System.

(i) Tools, etc.

(j) Trucks, cars, etc. The main cost here is the trucks on which the bricks are piled for drying, 180 trucks costing $9,800.00.

(k) Wagons, carts, etc. This is general equipment for cleaning up carting, etc.

## Cost of Production.

### MINING

| | Labor | Material | Total | Average | Total Average |
|---|---|---|---|---|---|
| 1. Shale | | 325.00 | 325.00 | .10 | |
| 2. Mining | 982.00 | 90.00 | 1072.00 | .32 | |
| 3. Total mining cost | 982.00 | 415.00 | 1397.00 | .42 | .42 |

### MAKING AND DRYING

| | Labor | Material | Total | Average | Total Average |
|---|---|---|---|---|---|
| 4. Manufacturing | 3392.00 | 150.00 | 3542.00 | 1.09 | |
| 5. Power & fuel | 785.00 | 3155.00 | 3940.00 | 1.25 | |
| 6. Mach.. &. tools main | 225.00 | 653.00 | 878.00 | .27 | |
| 7. Total making & dry | 4402.00 | 3958.00 | 8360.00 | 2.61 | 2.61 |

### SETTING AND BURNING

| | Labor | Material | Total | Average | Total Average |
|---|---|---|---|---|---|
| 8. Wheeling and setting | 1788.00 | ...... | 1788.00 | .55 | |
| 9. Kiln work and repairs | 1020.00 | 700.00 | 1720.00 | .53 | |
| 10. Burning | 700.00 | 3200.00 | 3900.00 | 1.25 | |
| 11. Total setting and burning | 3508.00 | 3900.00 | 7408.00 | | 2.33 |

### PLANT EXPENSES INDIRECT COST

| | Labor | Material | Total | Average | Total Average |
|---|---|---|---|---|---|
| 12. General | 1125.00 | 375.00 | 1500.00 | .471 | |
| 13. Building maint. | 662.50 | 100.00 | 162.50 | .05 | |
| 14. Depreciation | ...... | 3750.00 | 3750.00 | 1.22 | |
| 15. Fire Insurance | ...... | 350.00 | 350.00 | .114 | |
| 16. W'kmen's comp'n | ...... | 462.00 | 462.00 | .15 | |
| 17. Taxes | ...... | 1078.00 | 1078.00 | .35 | |
| 18. Overhead expenses | 1880.00 | 2600.00 | 4480.00 | 1.35 | 3.705 |
| 19. Grand total mfg. cost | | | | | $9.065 |

To this cost must be added loading cost to arrive at the complete f.o.b. cost.

| | |
|---|---|
| 20. Loading cost | .75 |
| Grand total cost | $ 9.815 |
| 21. 10 per cent for contingencies | .985 |
| Grand total | $10.80 |

This estimate has been taken from figures covering three months.

PRODUCTION ........... 3,250,000 brick.

In order to have a thorough understanding of the above statement each item wil be dealt separately.

1. Shale. This charge is made to cover the cost of land and should provide for the eventual exhaustion of the shale deposit.

2. Mining. This covers the labor and materials used.

3. Total mining cost. This is the total cost of the shale at the pit ready for delivery to the factory.

4. Manufacturing. This includes labor in the pringing, pugging and making operation, also lubrication, but does not include repairs.

5. Power and fuel. This includes fuel in the power house, and for drying as well as labor around the power house and dryers. Power, heat and light for all departments is also included.

6. Machinery and tool maintenance.

7. Total making and drying. This represents the total cost necessary to transform the shale into dried green brick ready for setting in the kiln.

8. Wheeling and setting. This represents the cost of removing dried brick from the dryer to the kiln and setting in place ready for burning.

9. Kiln work and repairs. This covers the cost of labor and material to close the kiln preparatory to burning and hauling out culls. It also covers the costs of kiln wall repairs.

10. Burning. This covers the cost of fuel, firing and necessary labor in connecting with the burning.

11. Total setting and burning. This represents the cost necessary to transform the dried brick to the finished article.

12. General. Under this is included superintendents and miscellaneous expense not properly chargeable to any specific amount.

13. Building Maintenance.

14. Depreciation. It is impossible to accurately determine at what figure this should be put, as it is

made up of two distinct phases, wear and tear and obsolescence, but it should be included in all production statements.

15. Fire insurance.

16. Workmen's compensation.

17. Taxes.

18. Overhead expenses. A great number of factors enter into this item, of which a few might be mentioned—administration, office, interest on indebtedness, bad debts, selling.

19. Grand total manufacturing costs. This gives the total cost of finished article.

20. Loading cost.

21. 10 percent for contingencies. This item is charged for any variations that may occur.

The above cost of production shows that in order to provide for a 10 percent return on the investment it is necessary to sell the brick at $12.80 per M.

# The Romance of Asphalt

## Some Historical Facts Concerning the Oldest Adhesive Material Known to Man—The Methods of Preparing Asphaltic Materials

Asphalt is the oldest adhesive agent known to man, and was used as a cementing medium by the Ancients; a mastic cast of molded clay and asphalt has been found near the Euphrates dating back to the year 2850 B.C., and as early as 2500 B.C., the Egyptians utilized liquid or melted asphalt as a preservative coating for the cloth wrapping of mummies. Its waterproofing value was also known at this date and there is good reason to believe that the ark built by Noah, was treated with asphalt within and without for this purpose.

Authentic records show that as early as 700 B.C., it was employed by a Babylonian king to fill the interstices of a brick pavement. This must have been a true natural asphalt, and which undoubtedly occurred in the form of springs and pools, such springs and pools still exist, in some parts of Asia but in too limited quantity for commercial purposes.

Sandstone rock and limestone rock, impregnated with asphalt are found in large quantities in Switzerland, Italy, Germany, and Sicily; asphalt pavement was laid in Paris, in rather a crude manner, and this was followed in 1858 by the construction of a pavement more nearly representing present practice. In 1869, rock asphalt was first used in England to pave Threadneedle Street, London, and in 1870 it was used in experimental paving work at Newark, N.J., opposite the City Hall. Bituminous rock from California was used as early as 1868, to cover an old wooden pavement in Santa Cruse.

The results achieved from rock asphalt pavements in this country, have been decidedly varied. Nearly all pavements laid in the past five to twenty-years were put down with heated material; the Kentucky producers advocate the laying of their material without the application of heat.

In the eastern part of the United States in the early sixties, sidewalks and cross-walks consisting of coal tar mixed with gravel,, broken stone, and coal ashes were lead under a patented process. In 1867, a small part of a roadway in Prospect Park, Brooklyn, was paved with this material. The experiment was so successful that in 1868, Lenox Road, Flatbush, Brooklyn, was paved with a foundation five inches thick consisting of two inch broken stone mixed with sand, coal ashes and tar, and with a wearing surface similar to that foundation, with the exception that no stone larger than one inch was used. This pavement lasted for almost twenty-years and when the street was repaved in 1896 a part of it was found to be intact and served as a foundation for a new asphalt pavement. This street is considered probably the first one regularly paved with bituminous material in the United States. This type of construction gave good satisfaction, but owing to the volatility of the tar, the streets had to be closed for a period ranging from thirty to sixty days after completion, in order to permit their use.

To overcome this, the Abbott patent consisting of a combination of roofing pitch and creosote was used as the binding material and came in use in 1871. Streets in Washington and Brooklyn, were laid with this mixture and were in good condition for fourteen or fifteen years; as these pavements failed, asphalt was laid over them, and with the previous example cited are the pioneer examples of bituminous foundations for bituminous pavements.

The first asphalt pavement laid in the United States, was in front of the City Hall in Newark, New Jersey in 1870, with Trinidad asphalt as the cementing material. The result achieved from a Trinidad pavement at Newark, and similar pavements in Philadelphia, and New York, attracted the attention of the authorities of Washington, D.C., with the result that a special commission was appointed by Congress, to investigate and report as to the possibility of adopting them for that city; it resulted that Pennsylvania Avenue, from First to Sixth Streets, was paved with rock asphalt by the Neuchatel Asphalt Company, in '76 and '77, and from Sixth to Fifteenth Streets, at the same time with Trinidad asphalt.

In 1891, asphalt from Bermudez, Venezuela, was introduced for paving purposes; Woodward Avenue in Detroit was paved with that material in 1892. It was found that both Trinidad and Bermudez asphalts, must first be subjected to a refining process in order to remove extraneous material and when thus refined must be combined with a residual petroleum oil known as Flux oil, by which means an asphalt cement of proper consistency or hardness can be secured.

In the late '90's pavements with asphalt obtained by refining California petroleum were laid east of the Rocky Mountains. Some of those were constructed in New York City between the years 1897 and 1904, under long term guarantees, and official reports put the cost of repairs to Jan. 1st, 1914, as ranging from nothing to two cents per square yard. The Asphalt cement was known as California "D" grade

With the growth of the petroleum industry and the increased demand for asphalt, petroleum refineries quickly learned how to manufacture asphalt from asphaltic petroleum. The first commercial asphalt thus produced was manufactured from California petroleum and was known as petroleum asphalt to distinguish it from asphalts produced in nature. After a comparatively short period of experimental refining, it was found that high grade asphalt could be successfully manufactured from certain petroleums and that the purity and consistency of such asphalts could be scientifically confined within very narrow limits. So, by a single operation, asphalt suitable for any desired use is now produced, which explains the ever increasing demand for its use in highway construction and for many other purposes.

Crude lake asphalt must invariably be refined before it is suitable for use in highway construction. The refining process is conducted in large metal tanks heated by means of steam coils and equipped with perforated pipes through which air or steam is forced for the purpose of agitation, so as to prevent local overheating and consequent injury of the asphalt. The chunks of crude asphalt are thrown into the tank and melted. The temperature is then gradually raised until all the water and light oils are evaporated Vegetable matter floats to the surface and is skimmed off while the coarser particles of mineral matter settle at the bottom. The refined asphalt may then be drawn off and barrelled. It is invariably too hard for direct use and must be softened to suitable consistency by mixing it with a fluid petrolenm product known as Flux oil.

The fluxing process is sometimes conducted in the original tank after the crude asphalt has been refined. it consists merely in agitating the asphalt with the proper amount of flux until a homoegeneous product of the desired consistency is produced. When the fluxing process is not carried out at the refinery the refined asphalt must be fluxed at the paving plant before it is mixed with the other constituents of the pavement.

The cude Trinidad asphalt contains only 39% bitumen, or asphalt proper, 29% of water and gas, 6% of organic or vegetable matter and 26% mineral matter, mostly clay. When this material is heated in the refining tank, water, gas and volatile oils are evaporated. Most of the vegetable and mineral matter remains in suspension in the asphalt and is therefore present in the refined product. By loss of volatile materials the percentage of bitumen is of course, increased in the refined asphalt which remains behind. The refined asphalt, however, contains only 58% of asphalt proper.

This refined asphalt being too hard for direct use must be softened with flux. Flux oil is entirely soluble in carbon disulphide and is therefore. all bitumen It is at once evident that any combination of refined Trinidad asphalt and flux must contain a greater percentage of bitumen than the refined asphalt. A typical combination shows that the bitumen has been increased to 64%. This 64% then, represents the asphalt in the asphalt cement. As the remaining 36% of organic and mineral matter have no binding value, it is evident that a greater quantiy of such an asphalt cement will be required to bind the mineral constituents of a given yardage of pavement than if the asphalt cement were all bitumen.

Asphalt is refined from crude asphaltic petroleum in 50,000 gallon cylindrical iron stills, set horizontally and heated from below. Inside they are equipped with perforated pipes through which steam is forced during refining. The process is very simple and quite similar to that described for lake asphalt except that, because the volatile products have considerable commercial value, they are carried off from the top of the still through a vapor line and condensed in water cooled coils.

The temperature of the oil in the still is never allowed to exceed 600 or 700 deg. F., and this coupled with steam agitation prevents injury to the asphalt left behind. As distillation progresses the material remaining in the still becomes more and more viscous until finally a semi-solid or solid residue is produced. Distillation is stopped when the asphalt has reached the desired consistency. No fluxing is therefore necessary.

In the manufacture of asphalt fillers for brick pavements it is customary to blow air through the melted asphalt at a certain stage in the refining process. This produces a higher melting point asphalt than would be produced by a straight steam distillation. Except for water which is removed by distillation, petroleum is practically pure bitumen. It therefore, follows that petroleum asphalt is pure bitumen, and its use does not have to take into account the presence of vegetable and mineral matter.

Statistics of the Geological Survey show the growth of the asphalt industry in the United States. Until 1911, imported native asphalt, mainly Trinidad and Bermudez, led all others. In 1902, petroleum asphalt was introduced in commercial quantities and its production from domestic petroleum has grown very rapidly since 1910. Even more remarkable has been the production from Mexican petroleum since 1913. In 1919, about eight times more asphalt was produced from petroleum than was imported from Trinidad and Venezuela.

## Military Experiences Abroad

A very entertaining talk, which touched on many topics, was given by Lieutenant-Colonel Holman James, of the British Army, at the Montreal Co-operative Electrical Luncheon on May 11. Lieut.-Col. James related incidents in his military experiences in South Africa and in France; his association with the Commission of National Service in London; and also his experience ranching in Western Canada. Speaking of his travels in the United States, Lieut.-Col. James alluded to the opportunities he had of testing the real feeling of the country toward the British people. He had found, he said, that there was lots of good feeling and amity in the depths of the American heart responsive to everything honestly calculated to stir it in their fellow Anglo-Saxons in other parts of the world. Indeed, he suggested that an improper national consciousness in the Britisher, resident in the United States, unwilling to accommodate itself to the sentiment of the country in which their living was found, was sometimes responsible for "turning the edge" of an otherwise happy relationship. Altogether he thought it was a pity that the average Englishman did not know the American better than he did, for it was through this growing acquaintance that the feeling already existing might be brought to its fullest and best fruition, in mutual recognition they liked each other all the time and did not know it.

# The Need for Standardization of Building Codes

## Unnecessary Variations in the Building Requirements of Different Cities—Greater Uniformity in the Matter of Wall Thicknesses is Desirable

In an effort to encourage building and stimulate interest in house construction, an important and practical suggestion, is to revise building codes and to make their requirements as nearly uniform as possible throughout the country. In almost hundreds of cities, building codes are now in operation which were prepared or approved a decade or more ago and have not been revised or amended since that time. These codes fail to take into consideration the advances made in the scientific and efficient use of structural materials and, in numerous cases, changes might be made which would reduce building costs while still retaining safe structural requirements. In a paper presented at the recent 54th annual convention of the American Institute of Architects, Mr. D. Knickerbocker Boyd brings out some interesting information regarding the thickness of wall requirements in the various building codes and their effect on cost and plans of small houses. An abstract of the paper follows:

### Code Provisions for Brick Exterior Walls.

One of the most obvious of these necessary revisions, relating to wall thicknesses, was brought to light recently in an investigation by the Structural Service Bureau of some 100 building codes throughout the country. These results thus far verified are tabulated as follows:

CODE PROVISIONS FOR BRICK EXTERIOR WALLS IN DWELLINGS.

| | Cities. |
|---|---|
| One story dwellings, 8 in. walls | 63 |
| One story dwellings, over 8 in. walls | 14 |
| Two story dwellings, 8 in. walls both stories | 28 |
| Two story dwellings, over 8in. walls, first story | 31 |
| Two story dwellings, over 8 in. walls, both stories | 19 |
| Three story dwellings, 8 in. walls, all stories | 6 |
| Three story dwellings, over 8 in. walls, first story | 10 |
| Three story dwellings, over 8 in. walls, first and second stories | 21 |
| Three story dwellings, over 8 in. walls, all stories | 39 |

Schedules have been prepared which list the variations and give the width, area and height limit of houses in relation to each thickness of wall. The lists are prepared on a generally comparable basis as to size of house and give the requirements, according to latest available information for a 2-story house.

The same city is in some cases included on two lists, apparently contradictory. This is due to the code requiring thicker walls inside the fire limits, or special regulations covering areas or heights. An example of this is Albany, N.Y., where 8-in., walls are permitted in the second story of a 2-story dwelling, outside the fire limits, but when inside the fire limits, a 12-in. wall is required—whereas in New York City, or in Philadelphia, the 8-in. thickness is permitted in both stories within the fire limits.

The first list includes some 29 municipalities permitting 8-in. walls in each story of a small two-story house.

The second list includes cities requiring the walls in the first story of a small house to be 12-in. or 13-in., thick, but providing for an 8-in. or 9-in., wall in the second story.

The third list includes those cities which require the walls of each story in every small house two stories in height to be 12 in. or 13 in. thick. There are 19 cities on this list.

Consulting these lists it is plain that in some cities it is possible to construct a 2-story dwelling with 8-in. walls for both stories above basement, while in a neighboring city, perhaps not 10 miles distant, 12 in. walls are required throughout. Why should the thicker wall be required if the 8 in. wall is equally safe and is approved by 28 cities, among them some of the largest in the country?

### Effect of Wall Thickness on Cost.

Of especial interest to the home builder, is the fact that the use of an 8 in. wall means a saving to him in money and space. Just how much of a saving in money can be visualized by a specific example:

The following figures are based on two storied walls, not allowing for half stories, gables or for openings, and disregarding whether the foundations are of stone, concrete, brick or other solid material. In a house 20 x 30 ft.—using that merely as a convenient standard of size for the purpose of calculating—there will be a saving between an 8 in. wall and a 12 in. wall, of 12,500 bricks (in round numbers). Those extra bricks would mean, at the average current price, that from $250 to $300 has been added to the cost of the house for the brick alone, to which a like sum must be added for the cost of the mortar and the time of the bricklayers and helpers necessary in laying of the extra 12,500 bricks. In other words, a house of the same outside dimensions would cost from $500 to $600 more in Albany or St. Louis than it would in Pittsburgh or Seattle.

In addition to safe structural requirements and money savings there are other important features. The difference in thickness of the walls increases the area on each floor by about 30 sq. ft., or in other words, the 8 in. wall means about the size of a small bathroom or several large closets added to each story.

The coal required to produce the additional material for the thicker wall would amount to 6 tons for each house. While that means, in the cost of the coal at the place where the material is burned, we will say $50—which amount is included in the money saving before mentioned—think of the conservation of coal and transportation which an 8 in. wall effects. Six tons and its hauling eliminated with each house built! If we construct the walls in the smaller or isolated houses, hollow, with brick or hollow tiles, where hollow material is permissible, there is still a further saving of about 2½ tons of coal.

The U.S. Housing Corporation adopted for its war housing developments, the 8 in. thickness as standard for brick walls of houses. In all localities this thickness, which was only accepted after thorough investigation was used in spite of any prevailing regulations to the contrary. That corporation and the Emergency Fleet Corporation adopted the 8 in. thickness as an ample safe and sound all-time standard for small houses, and not as a war measure of expedient.

### Effect of Wall Construction on Plans.

As an instance of the effect that wall construction may have upon type of plan,—in the City of Philadelphia, 9 in. walls have long been allowed, but this thickness has been limited to a building not over 16 ft. wide. The operative builders of Philadelphia, found that they could sell much more readily, a house that had more light and more air than the old conventional type—a house with an L at the back and a narrow court.

But according to the Building Laws, they had to make the better-planned wider houses with walls 13 inches thick, therefore, many of them stuck to the old type of building; because being narrower it could have 9 in. walls and hence was cheaper. So the operative builders called on the chief of the Bureau of Building Inspection and explained the situation; and he, thoroughly convinced that a change was desirable, said: "We will prepare and submit an enabling act to the Legislature of Pennsylvania." And last year, among them all, they amended the 16 ft., act so that houses 20 ft., wide could be built with 8 in. walls and the type of plan for dwellings in Philadelphia is now developing into what is called the "airlight" house without any back extension and departing from the old one with a narrow court-like yard.

## Smooth Pavements Are Money Savers

A census of city paving compiled by The Asphalt Association shows that the asphaltic types comprising 50% of all pavements higher than waterbound macadam have crowded out the rigid block types of pavement and are overwhelmingly favored in present practice, in comparison with unsurfaced portland cement concrete. Among asphaltic types, sheet asphalt shows the largest percentage, although asphaltic concrete, including bitulithic and certain other specialized types are rapidly finding favor. Sheet asphalt alone includes a yardage more than double that of brick, its nearest competor.

Regardless of the improvements in the manner of preparing asphalt and asphalt paving materials, the opening of new sources of supply and the economics resulting from these causes, the asphalt pavement would not have its popularity but for its intrinsic worth.

Considering the essentials of the pavement, namely: low cost, durability, low cost of maintenance, readily cleaned, low tractive resistance, slipperiness, favorableness to travel and sanitariness, we find that in comparison with other well known types of street pavements, sheet asphalt is given the highest percentage, rating from the standpoint of a theoretically perfect pavement, by such authorities as Mr. George W. Tillson, formerly Chief Engineer of Highways, New York City, and Ira O. Baker, Professor of Civil Engineering, University of Illinois.

In citing one of the requisites of a pavement, that of favorableness to travel, it will probably be given a heavier weighted factor now than formerly, because traffic everywhere has increased in weight and density. In the past when the asphalt pavement caused great saving on the shoeing of horses and repairing of vehicles, so today its smooth resilient surface has a wonderful bearing on the cost of up-keep of tires and motor vehicles. The tire bill of America is estimated as one billion dollars annually, and the American Automobile Association in an effort to grade the various surfaces in accordance with what may be considered their relative destructive effect on tires, has prepared a chart showing five groups, the probable tire mileage it is possible to obtain on each group being expressed in percentage terms as 100 perfect.

Group No. 1, rated at 95 to 100 per cent., includes sheet asphalt, bituminous concrete, (good), bituminous and surface treated macadam, gravel, cement concrete with bituminous surface, wood and asphalt block, (smooth.)

Group No. 2, rated at only 35 per cent., includes waterbound macadam or gravel, (rough) earth muddy with deep ruts containing loose gravel and stones, or earth frozen or with sun-baked ruts, or covered with loose stones or sharp gravel.

A billion dollars is a sum difficult to realize, but it is more than three times the cost of the Panama Canal, and 70% of the value of all passenger automobiles manufactured in 1919. Mr. M. O. Eldridge, Director of Roads of the American Automobile Association, says:

> It is high time, to pay more attention to the effct of the various road surfaces on motor vehicles instead of considering only the damage by the motor vehicle to the road. Compare, for instance, the smooth resilience of Fifth Ave., N.Y., (paved with sheet asphalt) with the rough gritty and flinty surfaces so often encountered on country roads, and try to imagine what a tidy sum in tire bills would be saved if we could all travel on avenue surfaces. The saving in tire costs alone would pay the difference in construction costs in many instances."

## 150 New Houses to be Erected in Toronto

A large tract of property in Toronto, lying east of Coxwell Ave., fronting on Small St., and running north to Gerrard, has been aquired by a syndicate of Toronto and American capitalists as sites for about 150 moderately priced homes. The land has a frontage of between 4,000 and 5,000 feet and cost in the neighborhood of $125,000.

As soon as arrangements can be made with the Works Department, it is the intention to start work immediately on 20 or 30 houses and build the remaider as these are disposed of. The houses will cost from $4,000 to $5,000 each and are to be surrounded with sufficient land to make them desirable.

# How to Land Your Prospect

## The Selling Game Requires Confidence, Earnestness and Hard Work

By Thomas Howard before California Edison Co.

How to "land" prospective customers is an interesting subject for every salesman. This article deals more particularly with the sale of securities of a central station company, which are widely distributed among their customers, but it contains a variety of useful hints which may be copied to good purpose by any man who has something to sell and has confidence in his product.

Mr. Howard was recently addressing the district managers of his company on the best methods of closing sales. He asked "What is the method of procedure when a man goes fishing or hunting?" He knows that there is game or fish to be had. First, he gets down the gun, he caresses it lovingly, he polishes it, he swabs it out, he oils it. Then he gets cartridges, he packs his grub, and he talks to anybody who will listen to him about the places to hunt, and he grows enthusiastic. He is ready and willing to walk a good many miles? For what? To bring down his game. He has an object. That is what I want to impress upon all here; that to succeed in any line of endeavor you must have an object. You must have earnestness. You must have confidence in your ability, confidence in the thing you are selling —and confidence begets earnestness; and with confidence and earnestness and the right kind of goods you will succeed.

### Fishing for Prospects

There are a good many ways of developing prospects, but there is one sure way. That is, make a start. Approach someone on the subject that you are interested in, approach a dozen people, and I will guarantee that you will get enough information from the dozen to give you prospects, and so on ad infinitum. I will also tell you something else, which is this: that there is a law which is called the law of average. It may be 1 to 10, but it is sure and unfailing. It works something like this: you may call on fifteen people and make one sale, but you will surely get two out of twenty. You try it. According to your earnestness and your ability as a salesman, the average may be higher than I have mentioned. It means hard work and what we call stick-to-it-iveness, and if you do not make a sale in the first 10 or 15, stick to it. It works!

In the selling game a salesman must know something about his goods. In fact, the more he knows about them the more he can increase his average.

Now a fisherman gets his rod and reel; he gets the right kind of hooks, and the proper kind of bait for the kind of fish he is after. How careful he is to put the bait on the hook in a manner that is inviting to the fish! Then he throws in the line. After a while he gets a nibble. How earnest he becomes! He loses it! It was a big one! Does he quit? Not if he is any kind of a fisherman. He tries again; a nibble—a bite. He lands it! How quickly he baits again! He is beginning to get interested and he stays with it. That is the thought I want to impress upon you—that you keep on throwing in your line; the fish are there. They are hungry; they will nibble; they will bite; and according to your perseverance will be your catch.

### The Right Method of Approach

In soliciting prospects, the main thing to avoid is the negative answer. Frame your questions in such a way that they will require an affirmative. Do not say, "How would you like to purchase some Edison stock today?" The word "stock" is like a red rag to a bull, to some people. I like the word "securities" better. Just assume that they ought to have some shares—something like this: "My name is Blank from the Southern California Edison Company We are with the approval of the Railroad Commission putting before the people, a new issue of securities, bearing a very attractive rate of dividends; in fact, this is an A-1 investment bearing 8% on par or on actual investment about 8.51%." It is just like any other battle—get in the first lick if you can. Get it into his mind that it is a good thing for him. Tell him that Jones of the Bank has got a bunch of it, or any other person that is supposed to be shrewd, and finish up by inviting questions. You will find that the average person requires a little shove; in fact, we all like to be coaxed a little even if we are intending to invest. Put the personal equation to the front—they have the money and the Edison Company wants it, and if you want a thing bad enough, you will generally get it; and while the advertising that this company sends out is a mighty good thing, sometimes the idea created by this advertising lies dormant in their minds until they are approached by a representative of this company.

You have no doubt heard of "Old Scar Face," the old antlered deer that refused to be caught for many years. The old deer was stalked and hunted by experienced hunters. He had seemed to bear a charmed life. Apparently he was hit but always got away. Now, I have an "Old Scar Face" down in the Santa Ana district. I have stalked him and trailed him. I know where he gets his lunch; I have made it a point to spot him a couple of blocks away and then walk towards him. He is conscious that I am after him. He is the kind of man with whom you broach your subject and then let it soak in. I want that prospect worse than any I ever got. I got a good shot at him the other day. He stumbled; he fell; but he got away. I was talking to two prospects on the street before coming to work and "Old Scar Face" said, "When you get through I want to see you." In his quiet way he asked, "What did you say that stock paid?" Did I land him? I did not. But I am going to get him. He might just as well take the hook now as later, because, while I am potting away at other game, I am always looking for "Old Scar Face."

### The Three Requirements for the Game of Selling

This game of selling requires three things: confidence, earnestness and hard work, and results will surely follow. All the world is a prospect, so I would say to you, "Go after them."

The most amusing experience that stands out in my memory in selling Edison securities was on the last active campaign. I was talking to the proprietor of a furniture store who already had some shares—and he is some booster, believe me. While we were talking he said he knew a man who he believed had some money lying idle. He called him on the phone and asked him to come down to the store. When the man came he asked the usual questions, then said he would take a few shares. I said, "All right, let's go over to the bank and you can draw your check." He replied, "No, I have the money. Wait here while I go and get it." In a few minutes he was back and when I saw what he had, over $1500 all in greenbacks, 5's, 10's, 20's and 50's, oh boy! I was so nervous I could hardly count it, and when it was rolled up I could hardly get it in my outside coat pocket. I saw him again a few days ago and he is expecting to sell a ranch; and if he does he will come through again.

In conclusion, let me repeat,—confidence in yourself and in what you are selling; earnestness in your talk as to its merits; and hard work in making calls—and the greatest of these is hard work. The fish are there, the game is there; the prospects are there. They have the money.

# Mainly Constructional

East and West—From Coast to Coast

A drop of $4.00 per ton in the price of lime and plaster is reported at Montreal. This means a reduction from $22.00 to $18.00 per ton in the price of the former article and from $32.00 to $28.00 on the latter.

Fire recently damaged the wooden building and plant of the Haileybury Brick and Tile Company, Haileybury, Ont., to the extent of about $22,000. Of this only $4,000 is covered by insurance.

At a mass meeting in the Labor Temple, Toronto, recently called to discuss the decision of contractors that carpenters wages should be cut to 80c an hour, commencing July 1, union carpenters, rejected the wage reduction.

Dearth of applicants for house bunlding loans, at Brandon, Man., has brought about the decision by the city council to return $125,000 of the $150,000 loan to the government for use in other departments retaining $25,000 for any possible applications.

Plans for the proposed new Masonic Temple at Windsor, Ont., have been prepared and call for a three-storey building, 112 X 110 ft., of up-to-date fireproof construction. Messrs. Nuxlow and Gale have the general contract for the construction of the building and Mr. J. C. Pennington is the architect.

Members of the American Institute of Chefical Engineers, in convention at Detroit recently, visited the plant of Messrs. Hiram Walker & Sons. at Walkerville, Ont., and after a trip of inspection through the large plant, were entertained at Glaser Pavilion, Willow Beach, by several large Walkerville manufacturers.

The Northern Hotels Co., Ltd., are contemplating the erection of a fifteen-storey addition to their Hotel Mossop in Toronto. It is reported that the plans of the architects, Messrs. Molesworth, West & Secord, of Toronto, have been adopted and 40-ft., of frontage immediately south of the present hotel, on Yonge St., has been purchased.

Mr. C. S. Walters, Inspector of Taxation, at Hamilton, has advanced a suggestion to relieve the present building depression. His suggestion was that the city grant exemption from taxation on houses erected for a period, say, of five years, the rent of the house to remain at the same figure for this period in return for the tax exemption concession.

The Car Owners' Garage Co. Ltd., are erecting a large garage on York St., London, Ont., which is the first of a string of garages they are contemplating building throughout Ontario. This building, which will be the headquarters of the company, will measure 157 x 110, and will accommodate 50 cars. Other garages being planned for the smaller centres will be of a standard 50 width, varying in depth according to the amount of accommodation required.

### Personal

Mr. Colin W. Campbell, contractor of Port Credit, Ont., was elected to fill the vacancy on the town's council caused by the removal of Mr. Wm. Clancy to Walkerton, Ont. Mr. Campbell, who has resided in Port Credit for over fifteen years, served overseas with the 19th Battalion, C.E.F.

Mr. L. A. Smith, has been appointed secretary-treasurer and manager of the Estevan Brick and Coal Co., succeeding his father, Mr. C. C. Smith, who has been in ill health for some time. At the regular semi-annual meeting of the company, the directorate was reorganized as follows; President, A. E. Rice; vice-president, T. Torgeson; directors, H. C. McWilliams and E. L. Thorpe.

Mr. Lawhence McFaul, of Owen Sound, Ont., has been appointed assistant city engineer of Hamilton. After graduating from the School of Practical Science, Toronto, he occupied the position of city engineer of Fort William, Ont., later going to Sault Ste. Marie, in the same capacity, which position he has occupied for the past eight years, with the exception of the time spent overseas with the Canadian Engineers.

### Obituary

Mr. William Henry Wilson, assistant superintendent of the Welland Canal, died in St. Catharines recently, after an illness of about five weeks duration. Deceased was 67 years of age.

### Incorporations

Quebec Housing Co., with head office at Quebec, capital $199,000, to erect dwelling houses.

T. E. Rousseau, Limited, with head office at Quebec, capital $49,900, to carry on the business of building contractors.

Canadian Benedict Stone, Limited, with head office at Montreal, capital, $230,000, to deal in stone, marble, brick, concrete blocks, etc.

Globe Builders Corporation, Limited, with head office at Montreal, capital, $50,000, to deal in roofing and other building materials.

National Slag Products, Limited, with head office at Hamilton, capital $300,000, to manufacture and deal in slag, portland cement, etc.

### Trade Publications

**Mussens, Limited, are distributing Bulletin 105 describing their various equipment, including an auto-crane, the Burch Stone spreader, Parsons' Excavators, the "B-G" Loaders and Conveyors and Holman Rock Drills.**

Greatest efficiency in the operation of G. & G. telescopic hoists can be secured only by the installation and use of several inexpensive auxiliaries. The relation of these to the whole is explained and illustrated in a pamphlet entitled "Ash Removal Equipment," issued by Gillis & Geoghegan, New York City. Specification writers who must determine the proper model of ash hoist to install under a given set of conditions will find their work simplified by the use of a recently prepared formula. Unlike most rules, this one has been constructed from the results of practical experience in the manufacture and installation of hoists for all types of buildings over a period of many years. Copies of this interesting and helpful booklet and formula will be sent free upon request.

ESTABLISHED 1886

# Contract Record and Engineering Review

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## Easier Money Would Vastly Improve Building Conditions

It is a common-place observation that the want of comparative activity in the constructional industries has been due, in large measure, to the high cost of materials and labor. This is partly true, although the restricted facilities in the way of securing capital has had a very important bearing on the subject. Contractors in the Province of Quebec, complain that mortgage companies either decline to lend money, or will only lend small amounts. This particularly applies to residences. This disinclination is a real obstacle to enterprise, as it puts an undue financial burden on contractors who, in many instances, are not in a position to assume the entire carrying charges.

A glance at the "Current Prices of Building and Engineering Materials," which appears regularly in another part of this issue, will show that the situation as regards building costs has greatly improved. Substantial reductions have been made in practically every classification. Skilled labor is at least 10% cheaper, as compared with last season, while unskilled labor is down even more than this. With these favorable factors, the outlook for the balance of the year is distinctly better. Constructional work is larger in volume, and with the smaller cost of building, it is fair to assume that some of thae projects which have been hanging fire, might well be proceeded with immediately.

We cannot say whether any further reductions will be made. Some of the materials are selling on a very small margin of profit or at a loss. The latter statement is certainly true of lumber, where the tendency will very possibly be upward. Under such circumstances the wisest policy seems to be to Build Now. The larger number of advertisements in our Tender Department is evidence that municipalities are alive to the fact that nothing is to be gained by further postponing building, roads, drainage, and engineering work generally.

But we cannot build without money and, as noted above, money is hard to get. This is not easy to explain because profits to the builder seem sure—so great is the demand for residences especially. One builder stated recently that a house costing him $2,800, say, to erect was selling readily at $5,000. As a matter of fact, in this case five houses were sold while the first two were still in the foundation stage. Our bump of caution seems to have got the better of our bump of reason, so far as house building goes, and the loan companies are among the worst in this respect.

## The Trend of Wages During 669 Years

The table below was compiled from information gathered from the continuous record of accounts relating to the work on buildings in London for more than seven centuries, some of which are Westminster Abbey, Westminster Palace, the Tower of London, Hampton Court, Whitehall, and Buckingham Palace.

It is claimed by the compiler (The Times, London, Aug. 31, 1920) that the lesson taught by this investigation is that wages when they have once risen never decline.

*Rates per day in the building trades in specified years, 1252 to 1920*

| Year. | Carpenters, masons, bricklayers, joiners. | Plumbers. | Plasterers. | Laborers. |
|---|---|---|---|---|
| | s. d. s. d. | s. d. s. d. | s. d. s. d | s. d. s. d. |
| 1252 | 0 2¼ .. .. | .. .. .. .. | .. .. .. .. | 0 1½ .. .. |
| 1253 | 0 3 .. .. | 0 3 .. .. | .. .. .. .. | 0 1½ – 0 2½ |
| 1258 | 0 3½ – 0 4½ | 0 3 – 0 6 | .. .. .. .. | 0 2 – 0 2½ |
| 1281-1284 | 0 5 .. .. | .. .. .. .. | 0 5 .. .. | 0 2 – 0 3 |
| 1285 | 0 4 – 0 6 | .. .. .. .. | 0 5 .. .. | 0 2 – 0 3 |
| 1287-1289 | 0 6 .. .. | .. .. .. .. | 0 10 .. .. | 0 2½ – 0 3 |
| 1292 | 0 6 – 0 6 | 0 4 .. .. | 0 6 .. .. | 0 2 – 0 3 |
| 1323-1325 | 0 4 – 0 5 | 0 8 .. .. | 0 4 – 0 5 | 0 3 – 0 3½ |
| 1324-1325 | 0 4 – 0 6 | 0 8 .. .. | 0 4 .. .. | 0 3 – 0 3½ |
| 1361-1362 | 0 5 – 0 6 | .. .. .. .. | 0 5 – 0 6 | 0 3 – 0 3½ |
| 1400 | 0 5 – 0 6 | .. .. .. .. | 0 5 – 0 6 | 0 3 – 0 3½ |
| 1441-1442 | 0 6 .. .. | 0 4 .. .. | .. .. .. .. | .. .. .. .. |
| 1450 | 0 6 .. .. | 0 4 – 0 7 | .. .. .. .. | 0 4 .. .. |
| 1494 | 0 6 .. .. | 0 6 .. .. | 0 6 .. .. | 0 3 – 0 4 |
| 1514-1515 | 0 6 – 0 8 | .. .. .. .. | .. .. .. .. | 0 4 .. .. |
| 1516 | 0 6 .. .. | .. .. .. .. | .. .. .. .. | 0 4 .. .. |
| 1530 | 0 6 – 0 8 | 0 8 .. .. | 0 7 .. .. | 0 4 .. .. |
| 1533 | 0 5 – 0 7 | .. .. .. .. | 0 7 .. .. | 0 4 .. .. |
| 1535 | 0 6 – 0 8 | 0 5 0 7 | 0 7 .. .. | 0 4 .. .. |
| 1538 | 0 6 – 0 9 | 0 7 .. .. | 0 7 .. .. | 0 4 .. .. |
| 1540 | 0 7 – 0 10 | 0 8 .. .. | 0 8 .. .. | 0 5 .. .. |
| 1558 | 0 8 – 1 0 | 0 9 – 1 0 | 0 9 – 1 0 | 0 5 – 0 9 |
| 1559 | 0 10 – 1 0 | 1 0 .. .. | 0 10 – 1 0 | 0 7 .. .. |
| 1567 | 1 1 – 1 2 | .. .. .. .. | .. .. .. .. | 0 8 .. .. |
| 1578-1588 | 1 0 .. .. | 1 0 .. .. | 1 0 .. .. | 0 8 .. .. |
| 1601 | 1 0 – 1 2 | 1 0 – 1 2 | 1 0 – 1 2 | 0 8 – 0 10 |
| 1603 | 1 0 – 1 4 | 1 0 – 1 2 | 1 0 – 1 4 | 0 8 0 10 |
| 1607 | 1 3 – 1 6 | 1 0 – 1 4 | 1 0 – 1 6 | 0 10 .. .. |
| 1612-1613 | 1 3 – 2 0 | 1 4 – 1 6 | 1 0 – 1 6 | 1 0 .. .. |
| 1621 | 1 3 – 2 0 | 1 4 – 1 10 | 1 6 – 1 10 | 1 0 .. .. |
| 1639 | 1 10 – 2 0 | 2 6 .. .. | .. .. .. .. | 1 2 – 1 4 |
| 1646-1647 | 1 10 – 2 6 | 2 6 .. .. | 2 0 – 2 4 | 1 2 – 1 4 |
| 1660 | 2 0 – 2 6 | 2 2 – 2 6 | 2 4 – 2 6 | 1 4 – 1 6 |
| 1667-1668 | 2 0 – 2 6 | 2 6 .. .. | 2 6 .. .. | 1 4 – 1 6 |
| 1677-1678 | 2 6 .. .. | 2 6 .. .. | 2 6 .. .. | 1 6 – 2 0 |
| 1686 | 2 6 – 2 8 | 2 8 .. .. | 2 8 .. .. | 1 8 – 2 0 |
| 1699 | 2 6 .. .. | 2 6 .. .. | 2 6 .. .. | 1 8 .. .. |
| 1778 | 2 6 – 3 0 | 3 0 .. .. | 3 0 .. .. | 1 8 – 1 10 |
| 1788 | 3 0 .. .. | 3 0 .. .. | 3 0 – 3 6 | 1 10 .. .. |
| 1790 | 3 0 .. .. | 3 0 .. .. | 3 0 .. .. | 1 10 .. .. |
| 1794 | 3 4 .. .. | 3 0 .. .. | 3 0 .. .. | 1 10 .. .. |
| 1796 | 3 4 .. .. | 3 0 .. .. | 3 0 – 3 6 | 1 10 – 2 3 |
| 1797 | 3 4 – 3 8 | 3 0 .. .. | 3 6 .. .. | 2 3 .. .. |
| 1801 | 3 8 – 4 5 | 4 0 .. .. | 4 4 – 4 6 | 2 3 .. .. |
| 1803 | 4 9 – 5 0 | 4 0 .. .. | 4 6 .. .. | 2 5 .. .. |
| 1808 | 4 10 – 5 0 | 4 6 .. .. | 5 6 .. .. | 2 5 .. .. |
| 1826-1847 | 5 0 .. .. | 5 0 .. .. | 5 0 .. .. | 3 0 .. .. |
| 1858-1861 | 5 0 .. .. | 5 0 .. .. | 5 0 .. .. | 3 0 .. .. |
| 1861-1865 | 5 10 .. .. | 5 10 .. .. | 5 10 .. .. | 3 [illegible] .. .. |
| 1865-1866 | 6 3 .. .. | 6 3 .. .. | 6 3 .. .. | 3 [illegible] .. .. |
| 1866-1872 | 6 8 .. .. | 6 8 .. .. | 6 8 .. .. | 3 11 .. .. |
| 1872-1873 | 7 1 .. .. | 7 1 .. .. | 7 1 .. .. | 4 4 .. .. |
| 1873-1878 | 7 6 .. .. | 7 6 .. .. | 7 6 .. .. | 4 [illegible] .. .. |
| 1914 | 9 7 .. .. | 10 0 .. .. | 9 7 .. .. | 6 8 .. .. |
| 1920 | 23 4 .. .. | 23 7 .. .. | 23 4 .. .. | [illegible] 10 .. .. |

# Filtration and Sterilization of Water Supplies

## Absolutely Essential for Public Protection—All Surface Waters Are Potentially Dangerous and Reliance Should Not be Placed Solely on Primary Lines of Defence

By Geo. A. Johnson, consulting engineer, New York, at the annual meeting of the American Water Works Association

Thirty years ago this country was the victim of gross ignorance respecting the disease-producing potentialities of water supplies. Typhoid fever was rampant, and in a single decade millions of people grievously suffered and hundreds of thousands died in consequence of disease brought to them by the unostentatious agency of impure water. Incidently, in this ten-year period there passed beyond all recovery the stupendous sum total of $2,625,000,000 in vital capital due to tyhoid fever alone.

Although in the space of this single decade one in every 35 persons in the United States contracted typhoid fever, the lay public saw nothing particularly alarming. But a few men more given to serious thinking than their fellows, and more skilled in the arts and sciences, pointed out that in the twenty biggest cities alone , 36,000 souls were being hurried towards eternity each year because of typhoid fever, and in that space quite one-tenth of these actually died. It was hinted that the vast bulk of this annual human expedition might have received its tickets from polluted water supplies.

Sundry remiedies were sugested. In the opinion of some, all water used for drinking should be boiled; others thought that it should be destilled; still others that it should be treated in domestic filters; while another group advocated the filtration of water used for the public supply of all needs. Still another faction submitted that initial prevention was the infallible cure for this desperate state of affairs; that quite the only thing to do was to stop pollution of all public waters. A branch of this element not only was disposed to prevent all initial pollution, but for fear somebody might slip in a few disease germs while the watch was asleep desired that the water should be allowed to impound in large reservoirs before use, that such incidental living contamination as might get by the prevention squad would thus be afforded time to repine and die of old age and discouragement through unrequited ambition.

### Wider Adoption of Filtration Methods.

Suffice it to say that of the 22,800,000 people supplied in 1890 from 1,878 public water works, less than 1.5% were furnished filtered water. The cholera epidemic in Hambourg had not yet occured to teach its striking lesson. The classic investigations at the Lawrence Experiment Station had only just gotten well under way. Frankland's invaluable studies on the removal of bacteria by water filters had not yet been developed on a decisive scale, and the scientific midn was still grouping about in the dark for the push-button which would force the illumination of the abysmal darkness surrounding the proposition of how to make impure water pure.

In the decade 1890-1900 things began to happen. Frankland was on the eve of proving that filters remove bacteria from water. The Hambourg epidemic proved that filtration of grossly polluted water would eliminate the disease germs it contaned. The studies at Lawrence, Providence, Louisville, Pittsburg and Cincinnati taught the craft how to purify water by practical means. About 1,500,000 more people were added to the total of those whose public water supplies were filtered, raising the grand total in 1900 to about 2.4% of the total population o the United States. The main acomplishment, however, was the development of precise knowledge of the menace in impure water and practical methods of correction.

The decade 1900-1910 was an era of accomplishment. Based upon the knowledge acquired in the previous decade, water filter plants were built in scores of cities, and the filtered water population increased from 2.4% of the previous decade to nearly 12%. One in every four people representing the urban population of the United States were being suplied with filtered water in 1910. Moreover in the ten years ending 1910, the typhoid fever death rate in the registration cities of the United States fell from 36 to 22 per 100,000 population living. The good work has continued through the decade just ended. Some 25,000,000 people are now supplied with filtered water, and the typhoid fever death rate in the registration cities has fallen to an average of 10 per 100,000 population living.

### Objectors to Sterilization.

Strange, to say, however, at this late and more enlightened day there persists an element among public sanatarians, the leaders of which still cling to the idea that it is permissible to rely upon primary lines of defence against water borne disease, such as depopulation and sanitary patrol of watersheds and storage of surface waters in impounded reservoirs. This element is not insensible to the additional and complete protection afforded by artificial processes of water purification, but for assumed reasons which are utterly beyond the ken o the author, they offer vague arguments against water filtration and sterilization "except where necessary."

The filtration or sterilizaton of all surface water supplies is always advisable and in the strictest sense always necessary. Certainly the cost attendant upon the ulilizateion of such defiinite lines of defence against water borne disease is justificable because of the assurance of water purity they afford. Minimiztion of initial pollution is splendid water supply saniation; storage is a link, however weak, in the preventive chain; but filtration and sterilization give the finishing touch, and with or without the aid of the primary measures of prevention just referred to, they afford the protection against water borne disease to which every citizen is entitled.

There are certain standard methods which, individually or combined, usually are followed in attempts to preserve the pristine hygenic purity of surface water supplies: (1) acquirement by purchase of the watershed. (2) diversion of isolated and community sewage from the streams draining the watershed, (3) community sewage purification where diversion is neither feasible nor possible, and (4) intense watershed patrol. The author wishes to place himself on record emphatically as favouring any and all reasonable attempts to head of at the source dangerous pollution of surface waters. Unfortunately, however there is a marked tendancy in some localities to place too great reliance on this form of water-borne disease prevention.

### No Assurance of Purity.

Under normal circumstances the acquirement by purchase of the entire catchment area is too expensive an undertaking to be considered for more than a brief moment. Furthermore a catchment area being purchased in its entirety, the circumscribed landscape profusely dotted with " No Trespass " notices, and the often more or less somnolent patrol given the charge of enforcing the no trespass rule, does not and cannot afford adequate assurance that the waters flowing from that area, uninhabited except by the patrol or chance trespassers, will not at some time become the vehicle of disease germs, grieviously to upset the fathers of the primary prevention idea, and the innocent ultimate consumers of these waters if furnished to them without purification.

Take a watershed and remove all habitations from it, place a sanitary patrol on the job to prevent the deposition of human excrementitious matter; and if there are birds or rabbits in the woods, or fish in the brooks thereon, or wild berries or flowers for the picking, that patrol must be a mighty energetic and conscience-driven body, individually as well as collectively, to stop at the indefinite confines of the watershed the rabbit hunter, the fisherman, the berry picker and the nature-loving flower gatherer. Then, too, patrolling a watershed is a lonesome job akin to sheep herding, and a little pleasant time-consuming intercourse with potential trespassers is not always rejected by the stern dictates of duty.

Where it is feasible on engineering and financial grounds to impound surface water in natural ponds lakes or artificial reservoirs, there is no question about the advisability of availing of this line of defence between the gathering ground and the ultimate consumer. The trouble is that too great and unwarranted confidence has been placed in water storage competently and consistently to remove the menace from such disease germs as may find their way into storage reservoirs.

### The Value of Storage.

The value of storage in the correction of the physical and hygienic imperfections of surface waters is very largely measured by the period of that storage; that is the time elapsing between the entrance and exit of the water in the reservoir. Factors which upset a definite measure of the benifits of water storage are stratification and various curents, temperature changes and wind action. A reservoir may have a theoretical displacement period of 100 days, and be considered in consequence a pretty fair purifying medium; but short-circuiting of the flow through the reservoir may actually cut the theoretical period of storage in a few days, or even hours, and by the same token this identical reservoir of which so much is expected, may then prove to be a delusion and a snare. Particularly is this condition aggravated when most of the reservoir surface is frozen over and the discharges from the entering streams follow a quite direct line from their points of entrance to the outlet of the reservoir. Temperature changes in the spring and and autumn of the year, bringing about the periodic " overturns " which produce complete vertical mixing of the water of the reservoir, upset all theoretical calculations. Strong winds toward the reservoir outlet tend to carry swiftly thereto the entering waters of the streams which feed it.

Water storage, in the concrete, will reduce the physical imperfections of a water through sedimentation, in extent depending upon the degree of quiescence, the period of storage, and the hydraulic subsiding values of the particles of suspended matter the water initially contains. It will reduce somewhat the colour of water due to vegetable stain through the bleaching action of the sun, but the sun is off duty for more than half the time, and even when patrolling its beat its bleaching action is manifested only at or relatively near the surface. Finally and what is the most important, storage of water will reduce the number of disease bacteria to a marked degree through the agencies of unfavourable environment, sedimentation, insufficient and unsuited bacterial food supply and the inimical activities of predatory protozoa.

### Water Easily Contaminated.

Storage of surface water in natural lakes and artificial reservoirs produces a benificial effect upon its physical and hygienic qualities, generally speaking but its action is not thorough, nor is it consistently reliable. If polluted water enters a reservoir, the chances are that sometime, under the primary influence of freshets, short-circuited flows, seasonal overturns, or what not, that pollution, in part at least, will find its way to the outlet of the reservoir. The pollution entering the reservoir need not be continuous or large in volume. Indeed the evidence is striking that the disease germ infected excrement of only one or two persons is sufficient to contaminate with disastrous results surprisingly large volumes of water. The experiences at Plymouth, Pa., New Haven, Conn., York, Pa., and Scranton, Pa., furnish incontrovertible evidence on this point.

In fine, while the storage of surface waters in large lakes or reservoirs has a decidely beneficial effect on the quantity of water, in the average situation, it cannot be depended upon as a consistently reliable performer in the field of water purification. The benefits of storage are here today and gone to morrow, because of factors in themselves beyond the power of man to control. Where a community desires a water supply as safe as the natural conditions or inventiveness of man can make it, and that water is derived from surface sources, something more is needed than the acquirement of the catchment by purchase, its subsequent unremitting patrol, and the storage of the runoff for days, weeks, or months. Too many physically thermal and human vagaries enter ito the problem to make it permissible for the sanitarian to stop at this point. The proceedure outlined may solve the conundrum for 364 days and 23 hours of the year, but in that one remaining hour all precedents, good intentions, convictions may be blasted from their inherently insecure foundations, and a disastrous epidemic of waterborne disease cast its pall of death upon a misguided community relying on part-way means of prevention.

### All Surface Waters Potentially Dangerous.

There is no sense in persistently residing in a fool's paradise, all surface waters be they derived from perpetually snowcapped mountain regions or from acquired , untenanted and patrolled areas, are potentially dangerous in that they are open to incidental, accidental or deliberate pollution. Storage of such water cannot be relied upon to make them continuously safe for human consumption. To presume that storage can be so relied upon is to ignore the epidemic arising from polluted impounded water supplies, and which are a matter of undeniable record. Such a position is untenable; is unnecessary because of the existing knowledge of how to make public water supplies entirely and continously safe by methods subsidary to storage; is fanciful because those whose mentalities convince them that it can be done for the reason that no disaster has yet attended their own practice in that primary line of disease prevention alone, have not had their personal lesson; and is romantic altogether in face of the facts.

The endeavour has been made to prove that the problem of making surface waters safe for public consumption involves the application of a chain of preventive measures constituting in effect four major lines of defence against water borne disease, namely: (a) Maintain the catchment area in as sanitary a condition as practicable, that is, guard against gross pollution entering the streams and lakes which guard the watershed; (b)store the water in natural lakes or artificial reservoirs, provided such storage is available or dictated by sound engineerng principals; (c) coagulate and filter; (d) sterilize.

There will be some variations in the application of these measures. The first (a) stands always unchanged as an elemental requirement of common sense and decency. In the case of the second (b), where natural facilities for storage are already at hand they will of course be made use of. Where they are not, and the construction of a dam to form a reservoir is required, aside from the purely engineering aspects of this phase, the only consideration which need be debated is whether or not the burden on the ultimate filter plant will be substantially lessened by prestorage for a long period. If the raw water is grossly polluted or heavily charged with mud, silt or clay, such storage is sometimes highly advantageous. In the third case (c) there may be instances where coagulation is unnecessary and where cost and other factors, including local public sentiment, indicate slow sand filters.

Only where coagulation is unnecessary, and where climatic conditions and the chemical composition of the ,raw water are favourable to such treatment should slow sand filters be considered. The writer prefers the rapid sand filter in any and all cases. It is less easily upset by climatic changes, and in competent hands is susceptible of less likelihood of " going wrong," and of more ready readjustment if it should, than is the old fashioned slow sand filter.

Respecting sterilization, this should never be omitted from the list of preventive measures. It should not be used alone except in those very rare cases where the raw water is all of the time, without any exception, free from suspended matter. In all cases the practice should be made of applying the sterilizing agent continuously, never periodically. To sterilize only when it " seems to be necessary " is as pernicious a practice as temporarily suspending the operation of a filter plant or use of a coagulant when the water looks all right.

In by far the great majority of relatively large communities, the problem of protecting the public from water-borne disease should embrace the application of watershed pollution minimization, and purification by sedimentation, coagulation, filtration and sterilization. Any community would do well to set up for continuous maintenance all of these lines of defense. To rely solely on the primary line of prevention, watershed patrol and water storage, is to invite inevitable disaster. Disease germs never send a herald in advance to proclaim their coming, and it is true water works and general civic economy always to be thoroughly prepared for their complete and satisfactory reception. Then, but not otherwise, the ultimate water consumer may drink, not only with his eyes but freely, satisfyingly, and without hazard of his life.

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# Business Administration of Highway Affairs

### A. R. Hirst Emphasizes the Need of a Proper Organization—How Efficient Highway Departments Can Be Built Up

In an address on "The Importance of Business Administration in Highway Affairs,"(A. R. Hirst, former state highway engineer of Wisconsin, told the Portland Cement Association that the highway programs now contemplated, called for an expenditure of so much money that political interference must not be allowed to effect the proper adminstration of the funds. His address further indicates how organizations of the character of the Portland Cement Association, may help to secure a business like handling of the road situation. In this connection his remarks follow:

Each man, you know, boosts his own game. To the man who manufactures cement, the business of munufacturing cement is, naturally, the preeminent enterprise. He shouldn't be in it unless it is that to him.

However, many of you gentlemen think of selling cement to a state or county merely as selling cement and when you have moved so many hundred thousands or so many million barrels you consider that your part of the enterprise is completed. I am not criticising the worth of your promoting organization, the Portland Cement Association. I have been in the highway business for eighteen years and as far as I know and have seen, it has carried on the cleanest, highest class propaganda for the promotion of a highway material that has been carried on in America. You have been insistent on high class specifications for high class roads. You have never let down an inch. You have insisted that we should go further than we as engineers sometimes believe to be necessary, but by and large you were right.

There is just one more thing which I believe you should add to your chain and that in my impression is the most important one, and that is to join this propaganda, if you call it so, for the creation of a proper spirit in the minds of the people, so that they will build up adequate highway organizations to spend the millions they have made available for highway construction. You think, or at least you say you think, that concrete structures, concrete roads, concrete bridges, concrete culverts, are the economical type in a very large number of cases and that given an honest and experienced highway department, they will sell themselves on their merits as a business and ecomomic proposition. I don't debate that with you because I believe that they will. From yiur own selfish standpoint, if the production of concrete roads and concrete structures is to proceed, if they are the proper kind of structures for a county or state to invest its money in, your own safety in advancing your interest is to help counties and states to secure and keep absolutely honest and experienced highway departments, because when you have those you have nothing to fear if your product and methods are right.

The bare engineering work in the construction of a few hundred roads and bridges, is more or less routine. A state with a proper organization can turn out a hundred miles of concrete road or a thousand, given the money, just about as prolifically as rabbits are turned out and cast just about in the same mould the one with the other. But the thing which you must guard against if you are going to build up a consistent business in highway materials is the lack of continuity of this performance. This thing of a state being prolific one year and using a couple of million barrels of cement and having an attack of cold feet the second year and using a couple of thousands, does not make for normal or consistent business or progress. As long as every politician who happens to be elected to any place sets himself up instantly as a highway arbiter to whom every i and t must be submitted and he must see that they are dotted and crossed, and he won't play at all unless the game is played just as he imagines it should be played, he throws monkey wrenches into the manchinery which does not make for consistent progress in our highway programs.

Your business in the next few years, in my opinion is not only to promote the use of cement in concrete roads and bridges, but over and above that to promote in the minds of the people the idea that they must divorce this one thing from politics, religion and favor. Let them have all the other state and county offices play politics with all the county clerks and the auditors and the coroners. If you will, let them play with them, pull their hair out by the roots, have them dye their hair when it's green and they want it blue, but make them understand, if you can, that while this country is rich, it is not rich enough to play the highway game as it has played it the last ten years. We must wake up, turn over and start again with the one idea that this is the greatest busines enterprise that our people have ever undertaken and that it must be made a clean cut and efficient operation.

# Construction Contracts Awarded in June Amounted to $26,436,800

Construction activity in June, according to figures published by MacLean Building Reports, Limited, was $422,700 less than in May. Contracts awarded amounted to $26,436,800 compared with $26,859,500 in May, and by provinces are as follows:

| | No. of Projects | Value |
|---|---|---|
| Ontario | 1,027 | $7,506,800 |
| Quebec | 360 | 6,861,100 |
| British Columbia | 292 | 5,091,500 |
| Alberta | 167 | 2,776,000 |
| Manitoba | 231 | 2,214,700 |
| Saskatchewan | 103 | 1,188,100 |
| Nova Scotia | 69 | 411,600 |
| New Brunswick | 35 | 368,000 |
| Prince Edward Island | 5 | 19,000 |
| Total for Dominion | 2,289 | $26,436,800 |

Residential building continues very active. In June, contracts for this class of construction totalled $7,943,600 or 30.3% of the total. Business buildings amounted to $10,027,800 or 37.6% of the total; industrial buildings, $458,700 or 1.7% of the total; public works and utilities, $8,006,700 or 30.4% of the total.

### Good Showing During First Six Months

Building activity for the first six months of the year compares very favorably with the same period in previous years. The total investment represented by building contratcs let from Jan. 1. to July 1 has amounted to $111,763,500. At the end of January activity fro the fiirst of the year to date was 7.6% above the average for the preceding three years, at the end of February, 21.9% ahead; at the end of March 8.7% ahead; at the end of April 8.6% ahead; at the end of May 8% ahead, and at the end of June 8% ahead.

### Building Costs Receding

The wholesale price index of 48 building materials declined to 309, a drop of 4.4 points for the month; making a total of 94 points or 23.5% from the high mark of May 1920.

### New Building in Sight

The demand for residences continues strong. Contemplated work was reported in June to the amount of $16,500,700, distributed as follows:

| | No. of Projects | Value |
|---|---|---|
| Ontario | 250 | $6,134,300 |
| B.C., Alta., Sask. & Man. | 284 | 5,423,100 |
| Quebec | 135 | 3,993,000 |
| N.S., N.B. & P.E.I. | 32 | 950,300 |
| | 701 | $16,500,700 |

During the first six months of the year, $168,748,500, contemplated new work has been reported. This is $56,985,000 more than the value of contracts awarded and indicates the pressure of the demand for construction. Architects report that in many instances bids are being recieved from contractors at a lower price than the architects' estimates. This indicates that material and labor costs have receded where a substantial increase in activity may be expected.

# 26,000 Yard Break from Blast at Trap Rock Quarry

## In an Attempt to Increase the Output of Their Quarry, the Ontario Rock Company Use One Large Blast—Ordinary Drilling and Blasting is Expensive as Rock is Very Hard

Twenty-six thousand cubic yards of trap rock were recently broken in one blast at the quarry of the Ontario Rock Company, at Preveneau, Ontario, about three miles east of Havelock on the Toronto-Ottawa branch of the Canadian Pacific Railway. This large blast was decided upon in an attempt to increase the output of the quarry, as the rock is so hard as to make the cost of ordinary drilling and blasting very expensive.

The quarry at Preveneau is the only trap rock quarry operating in Ontario at the present time. It was located during the geological survey of this area in 1907-8 by the Ontario Bureau of Mines. The rock is a dark green trap of the following chemical composition:

| | |
|---|---|
| Silica | 45.20% |
| Ferrous Oxide | 9.74 |
| Ferric Oxide | 8.37 |
| Alumina | 22.30 |
| Calcium Oxide | 8.02 |
| Magnesia | 1.51 |
| Soda | 2.59 |
| Potash | 0.46 |
| Water of Crystallization | 2.04 |
| | 100.25% |

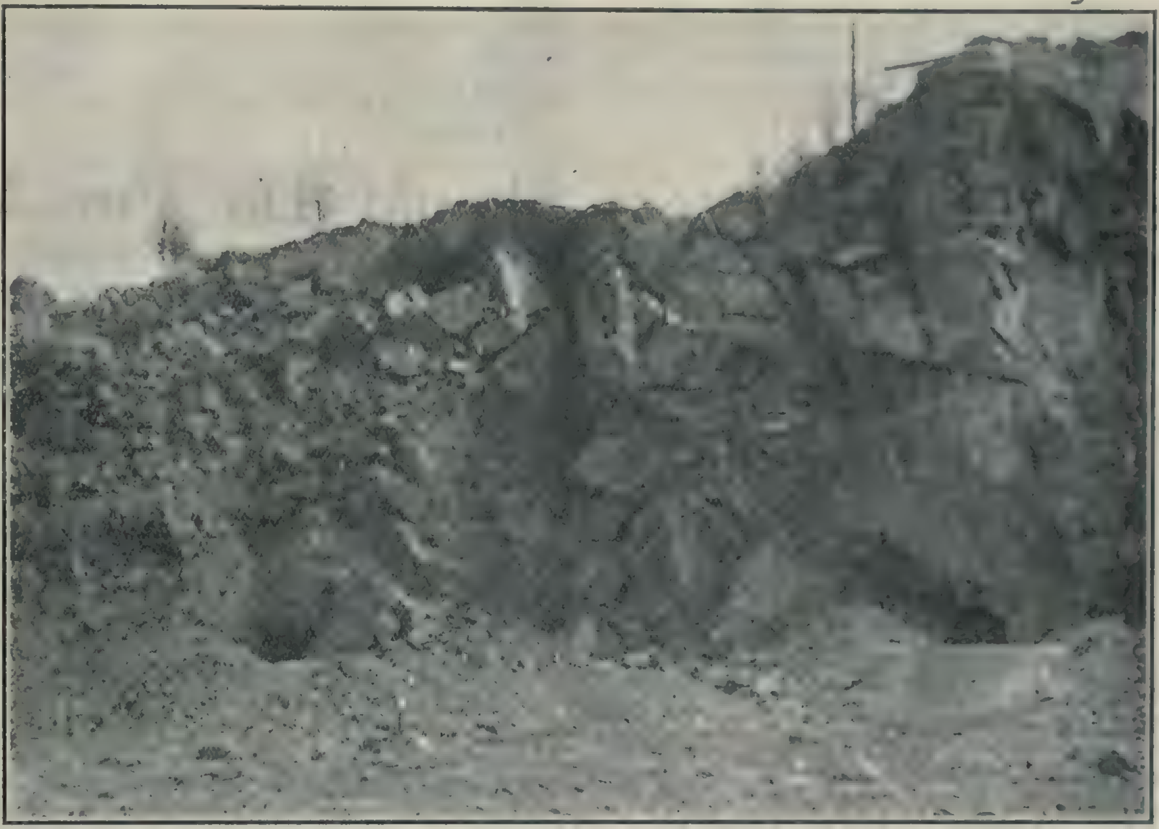
The big blast at the trap rock quarry of the Ontario Rock Co. near Havelock, Ont.

The physical properties are as follows:

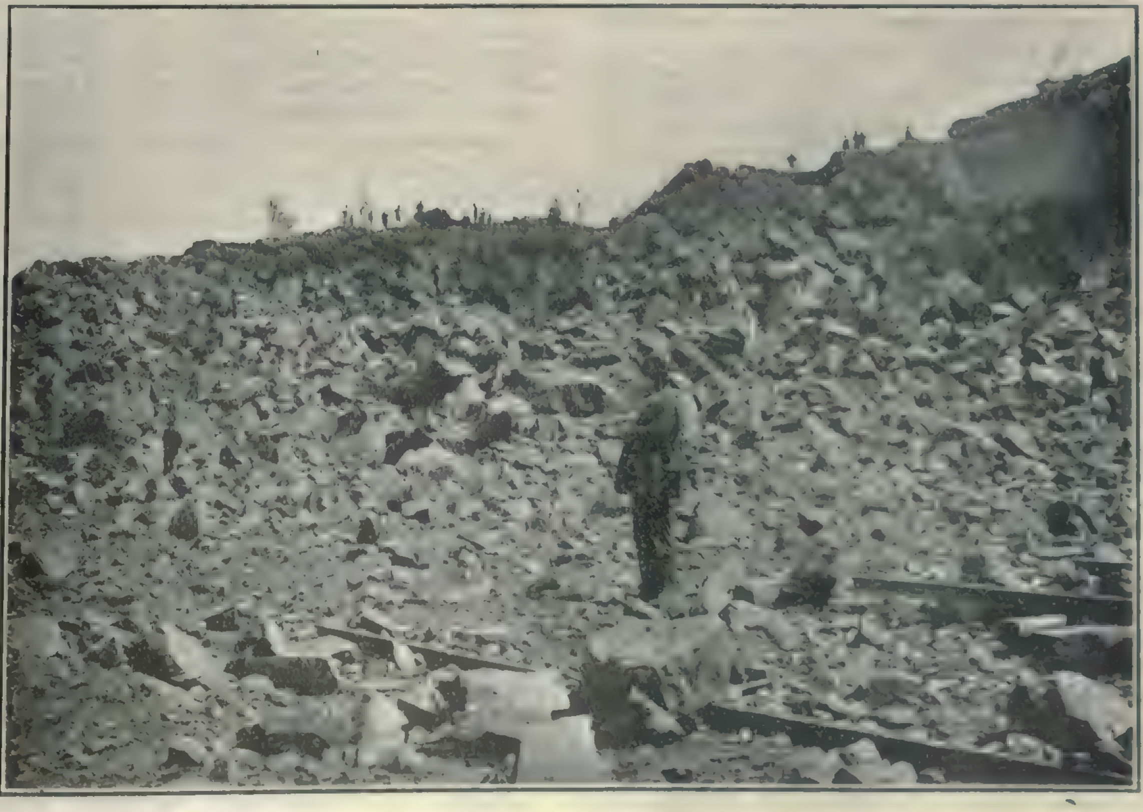
| | |
|---|---|
| Specific Gravity | 3.05 |
| Hardness | 20.00 |
| Toughness (impact test) | 20.00 |
| Abrasion | 2.5 |
| Cementation | 39.00 |
| Crushing Strength, 37,300 lbs. per sq. in. | |
| Weight per cubic foot | 181.78 |
| Pore space, per cent | 0.44 |
| Ratio of absorption | 0.14 |
| Coefficient of Saturation, 1 hour | 0.075 |
| Coefficient of Saturation, 2 hours | 0.087 |

The product of this quarry is very extensively used, especially in the city of Toronto, and the county of York, on roads and pavements and in building construction.

When it was decided to use one large blast, two adits were started, the westerly one being under fifty feet of back, and the easterly one under 65 feet of back. The first adit was driven 60 feet north and cross headings, were run 60 feet west and 10 feet east. Three pockets were made in the south side of the west cross heading. Cross headings were also driven at a distance of thirty feet from the portal. These were loaded with 180 cases of 60% nitro-glycerine distributed in seven charges. In each charge two



The quarry of the Ontario Rock Co. showing 60 ft. face and entrances of blasting adits



The quarry after the explosion

No. 8 electric detonators were used.

The east adit was driven sixty feet to the north, and at 25, 30 and 60 feet from the portal cross-headings were driven 30 ft. east, 30 ft. west, and 30 ft. west, respectively. These headings were loaded with sixty cases of 60% nitro-glycerine and 120 cases of black powder, divided into nine charges with two No. 8 detonaters in each charge.

The charges were covered with oiled paper and tightly packed with sand. The adits were packed as tightly as possible with rocks, and at thirty foot intervals the face of the rock was covered with a foot of sand.

The actual yardage broken was about 26,000, which was 2,000 cubic yards in excess of the estimated break.

# What a Cost System Should Do For You

## Tends to Ensure Adequate Profits—Shows Leaks and Weak Spots—Points Out Unprofitable Lines—Desirable Check on Manufacturing Activities

By E. W. McCullough*

(This is the first of a series of articles which are being prepared by Fabricated Production Department of the U.S. Chamber of Commerce. The second installment, "Overhead Expenses and How to Distribute Them in Good and Bad Times" immediately follows this article. These articles, while intended primarily for manufacturers, will be of helpful value also to contractors, supply men and manufacturers of building materials.—The Editor)

Individuals' memories are limited in the number of accurate records which they can retain. Business consists of transpiring events, all of which must be properly attended to. The solution of the problem of securing reliable records of many transactions without depending upon the fallibility of memory has been found through systematic methods for conducting the operations of business. One of the very important matters relating to business operations, and one in which a number of records are involved is cost accounting.

Primarily, a business to exist must make money. This means that something must be disposed of for more than it has cost. Every manufacturer, therefore, is vitally concerned with the two items—cost and profit. The problems presented in labor, materials, production costs, and keen competition have made it necessary for a manufacturer to determine and constantly to know the cost of his product in order that his business may continue to be a profitable one, and earn the margin of profit desired. There is a definite dividing line between profit and loss, and the location of this dividing line can be and should be accurately determined.

### Gives Control of Business

Cost accounting is an accurate method for arriving at the cost of producing a complete and saleable commodity and delivering it to the carrier for transportation, reporting in usable records all of the various elements which go to make up these costs. Records of costs are valuable in themselves, yet it is the detailed information which they contain, available for ready reference, which is of utmost value. Accurate information regarding the various elements which go to make up costs, as contained in cost records, automatically eliminates arbitrary, empirical, or guess costs which prevail to a surprising degree among many manufacturers. The cost system, like an X-ray picture, brings to light imperfect internal conditions and suggests correction.

### Checks Variations from Standard Practice

Among the many ways in which cost keeping is an aid to production are the following. It brings to light inefficiencies in system by calling to attention the cost of its operation and points out equipment that has become inadequate by showing an excessive cost of product coming therefrom; it points out employees who are below the standard required, and permits of performances being kept within certain limits by watching the accumulation of costs. Increased production depends largely on the intimate knowledge the management has of all elements in their manufacturing operations which can only be supplied through an adequate cost system. It enables them to establish proper control and increase output as warranted by the cost record.

In many plants considerable sums of money are spent to establish a standard practice of operation. From time to time certain variations from the established standard practice occur, affecting costs in an adverse way. Timely cost reports showing what is happening, rather than what has happened, suggest immediate correction of such inefficiencies. It is not sufficient that executives simply know that expenditures are excessive; they should be supplied with information to determine exactly where these excessive expenditures occur and take action. Definite responsibility for expenditures as well as the authority to make the expenditures should be fixed by an adequate system of cost accounting.

Overhead, or burden, consists of expense items which cannot be directly attributed to some particular product. It is composed of indirect labor and material, rent, etc. Overhead being variable, as related to output, and forming a material portion of a plant's expense, it is necessary that control over these accounts be rigidly kept. Control is possible only when accurate knowledge of the amounts entering into each item composing overhead are known. Guessing or estimating amounts of overhead, as well as arbitrary distribution without a sound basis for the allocation is uncertain and leads to unexpected results. Sales price does not affect overhead, but the amount of overhead definitely and absolutely affects sales price.

A factory manager should have before him detailed cost reports showing the expenditures necessary to produce articles. With this information at hand, he is in a position to note the variables and put into operation the movements necessary for their satisfactory control. In this respect, the cost system is similar to the nerve system of the body, its function being to transmit information regarding conditions in the entire plant to some central individual or body.

No one enters business to fail but the majority who do lose out do so from various causes, but principally because they disregard the question of costs. Your worst competition is largely from those who do not know what it costs them to produce and do business. When normal production returns, competition will force closer margins and costs must then be known. Why not now?

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The manufacturer who bases the sales price of his product on competition without regard to real cost, stands to sell his product at a closer margin than he desires and possibly at a loss. Whether the margin of the profit is ample or not the existing conditions are not known until the date when damage done is beyond repair.

### Determines Unprofitable Lines

It is generally conceded that unprofitable lines should be discontinued. Where a variety of articles are manufactured in a single plant a cost system offers the only opportunity for determining positively those lines which are not profitable. Where a single article is manufactured, timely information regarding costs can forestall a calamity.

The raw and semi-finished materials and finished stock are an important part of the assets of a company. Officials who do not properly account for them with respect to price, quality, and quantity, may arrive at a cost lower than is real. This means that profits will be shown as greater than they are. It is obvious that if dividends are paid on the basis of such profits, the capital of the company will be depleted.

A practical, usable cost system should not be complex, but lean toward simplicity. Neither should it require an investment out of proportion to the benefits to be acquired. It should be considered a piece of necessary equipment and treated accordingly; it will return its proportion of dividends on the money paid for it. The adoption of a cost system by a number in any industry, made uniform as to fundamentals, will be found of the greatest benefit in promoting more intelligent trade practices. Technical accuracy in costs, especially in lines involving minute operations, is not altogether desirable or necessary, but costs commercially accurate can always be obtained.

Cost systems, both as to manufacturing and selling, should tie in with the general accounting records so that financial statements drawn will reflect all conditions of the business accurately.

In the making of a budget, the greatest possible accuracy is desirable, and here, too the cost records of the past years afford dependable information.

When a business operates without a cost system, it is in the same position as a boat without a rudder, tossed about by the winds and directed by sources outside of those supposed to be in control, and driven towards an end which is not definite and perhaps not the one desired.

As we catch up in production a new era of competition will ensue, and war time margins will disappear. In their place will come percentages of profit earned by efficiency and determined by accurate cost reckoning.

# To Distribute Burden in Good and Bad Times

## Normal Overhead Best Basis for Figuring Costs--Does not Penalize Business when Production is Low—Each Year Dependent on Others

By E. W. McCulloch.

In the article "What a Cost System Should Do for You" which appears on the previous two pages of this issue, we called a good system an insurer of profits. Some may question this statement in times of depression when they find their unit costs rising 100% or more, largely because of the increasing overhead on their low or sub-normal production. Let us examine the situation by calling to mind those facts and fundamentals with which we are familiar.

A manufacturing enterprise in its simplest terms consists of:—

(a) A place to work,
(b) Machines to work with,
(c) Men to do the work,
(d) Material to work upon,
(e) And management to co-ordinate the whole.

Let us see what all this means. A place to work requires maintenance. It must be repaired and cleaned, heated and lighted and watched. A place to work bears taxes, rent and insurance and it also depreciates. Machines consume power and supplies, require insurance, attendance, repairs and cleaning and also depreciates. Men to do the work entail wages, liability insurance and supervision. Materials include provision for receiving, sorting, handling and shipping. Delivery of material alone may demand a heavy investment in trucks and garage, teams, waggons, and stable, forming, in fact, a compact separate miniature organization. Management takes care of the buying, selling, financing and administration, purchasing agents, salesmen, accountants, stenographers, stationery, postage, telephones, legal expenses, engineering, advertising, travelling, and so right down the line of what are known as general or commercial overhead expenses. Such is your manufacturing enterprise in crude outline. Elaborate it, departmentalize, unify and combine it, as suits your own requirements.

### The Activities Involved

That which gives life and vitality to your manufacturing enterprise is work,—something to do. It stirs the slumbering organism into action, starts the wheels a-grinding, the chimneys to smoking. How much work you can turn out,—what are the latent possibilities of your organization, — that is not often shown or demonstrated. Ordinarily your plant is idle sixteen hours out of twenty-four, and a day and one-half out of seven. Only in a great national crisis or emergency such as the recent war do we really speed up production and extract from our facilities the last ounce of usefulness. Otherwise we strike a steady normal gait of healthy activity below the limit of what we can do, above the limit of slacking or lagging. This normal, this mean or middle ground of possible capacity, is an ever-present fact in industry. It is there and should be recognized as a starting point in the discussion and treatment of industrial problems such as costs. Normal capacity is your 100 deg. mark, above which your organization registers in times of excessive or unusual activity, below which it drops in times of curtailed production and demand.

The even flow of work is subject to many interruptions. There are strikes and transportation tie-ups, machinery breakdowns, seasonable fluctuations, as in the ice business, and years of light demand, such as we are at present experiencing. What happens when there is no work or little work? Do the expenses incident to running a business cease or recede accordingly? Your building still carries its taxes, rent and insurance, and needs about the same degree of repairing, heat, light and watching, and meanwhile it depreciates. Likewise your equipment continues to depreciate and requires insurance and some maintenance. Theoretically you can discharge your men, but practically you find odds and ends of work, non-productive tasks, for the best of them, and of course you retain your superintendents and many of the foremen. You stop feeding the machines materials, but your money is still tied up, and the material deteriorates, and must be insured, properly stored and cared for. When it comes to the management, you cannot sacrifice your executives, your office, your best salesmen, your best engineers, accountants or clerks. Such are the considerable expenses incident to not doing business; expenses which go on for a considerable time whether or not you are doing a dollar's worth of business or work, expenses that must go on if the organization is to remain intact.

### Who Pays the Bill?

Since such interruptions of industry are still an ordinary incident of business, and carry a cost that must be reckoned, the business man hopes the consumer will pay for them. "I am offering a service to the community," he says. "If for considerable portions of time my facilities are unutilized, my plant and equipment idle, or marking time, I must include in my price an allowance for this item of suspended operation (inoperative contingencies the paper industry calls it); otherwise I cannot exist." Where facilities are based and attuned to the needs of the market, and are not a war-time mushroom growth, the demand of the business man does not appear unreasonable. The trouble very often is that his cost system does not show him how he can recoup such losses.

When the very considerable expenses of not doing business are applied in full to a reduced activity, very high costs result,—costs out of all relation to the true costs of production, and costs bearing no relation to what the market will bring. In such time two opposite tendencies develop. On the one hand the business man who is a firm believer in his cost system refuses to take business except on a basis of his inflated costs and thereby further restricts business at a time when the crying need is for more and not less business. The more skeptical business man feels there is something wrong with his cost system, proceeds to ignore it and sells his product for whatever he can get. This treatment of the cost system is more largely responsible for demoralized markets and prices than is realized. Meanwhile the plant is bearing the full brunt of slackened activity.

### Normal Year the Standard

Our cost systems are far too rigid. Under cost methods still largely in use overhead expenses are spread too thin in times of forced production and, massed too heavily in periods of slight demand and production, giving in the former case costs that are artificially low and unfair to the management, and in the latter case costs that are artificially high and unfair to the public, and moreover costs which the market will not sustain.

For the sake of convenience, we split up our business into years and treat each year as though it were separate, distinct and unrelated, whereas no such sharp cleavage exists. Year merges and glides into year, one dependent upon and connected with the other. The injustice and inaccuracy of a complete and abrupt cut-off is clearly illustrated by an income tax law which heavily taxes the profit of one year, and makes no compensating allowances for the losses of the following or preceding year's operations.

Cost systems should recognize this continuity of time wherein any single year or month may or may not typify and represent normal production and demand. There are expenses, it has been shown, which continue whether the plant is idle or in operation, expenses that moreover, bear no direct relation to output. Cost systems should provide that these expenses, usually designated as overhead expenses, should be absorbed and pro-rated on the basis of a normal year, —that 100 deg. mark on the business thermometer. Thus, in time of unusual production,—production exceeding normal,—the overhead should be more than used up in costs, and a surplus out of overhead cost created to take care of those years when the output is below normal and the overhead charges not fully absorbed in the costs of that year.

To take a very simple illustration: Let us assume the normal output of a department is 100 pieces and the overhead $100, or an overhead charge of $1 per item. If the department produces 150 pieces at a normal overhead charge of $1 per item, not only will the $100 overhead be used up but there will be an additional $50 as a reserve accruing to the management. When the output of the department drops to 50 pieces, only $50 overhead will be applied to this reduced production, and the difference made up from the reserve established during unusual production. This method of cost procedure has numerous advantages, two of which it is here appropriate to mention.

1. It will assure the business man a reward for his efforts in speeding-up.
2. It will eliminate the needless throttling of business by the impractical attempt to load semi-normal production with greater charges than can or should be borne.

### Operation Under Normal Year Basis

The determining of a normal year is not an easy matter. It requires a long look behind and a far look ahead. It is by no means sufficient to accept the operations of the preceding year as the sole standard. The normal year is different for a new organization or industry from what it is for one long established. The normal year does not remain on a dead level but should probably curve upward gradually and conservatively with the growth of population and markets. To do otherwise would indicate industrial stagnation.

To establish normal unit overhead charges, two things must be determined:—

1. Normal overhead expenses for the various departments of the business.
2. Normal production.

When the normal overhead expenses are divided by the normal production, the result is the normal unit overhead charge.

In determining normal overhead expenses, those expenses of the previous years which are accidental should be eliminated. An effort must also be made reasonably to anticipate and allow for the trend of expenses for the coming year.

But there is nothing conclusive, final or binding about this estimate of normal expenses. Each month your cost system gives the estimated overhead expenses and the actual expenses. If there is an increase of the actual over the estimated, and upon analysis that increase is found to be a real increase, due to unanticipated increase of salaries or insurance rates, etc., and not an inflation arising from reduced production, an adjustment upward can immediately be made in the unit overhead charges. Each concern will establish for itself a safety zone, below or above which decreases or increases in real costs will be reflected and taken up in the selling price.

In determining normal production due allowance must be made for interruptions of operation. Even in the job industries, which by necessity have been schooled to base overhead charges on a normal year, the tendency is still to base capacity on regularly operated machines. When these machines do not regularly operate, it is apt to go hard with the establishment. In a paper mill with a possible yearly operating time of 7,488 hours, the plant was idle 689 hours or not quite 10% of the time, because of the usual and customary interruptions, repairs and high water. How transportation tie-ups, strikes, and slackened demand in many industries affect production is, of course, familiar to all. In determining normal production, then do not delude yourself by placing it too high,—at a mark reached only in exceptionally fortunate years.

### Necessary Cost System Adjustments

Though cost accountants and industrial engineers are prone to using strange and technical terms for it, the accounting device used to secure operation on a basis of a normal year is the now familiar one of the Reserve, or a modification thereof.

For purposes of illustration, let us recall how a simple reserve, such as the reserve for bad debts, operates. The operating account "bad debts" is debited each month with the estimated amount of bad debts likely to be sustained, and the account "Reserve for bad debts" credited each month with a like amount. As bad debts are actually sustained, the amount thereof is debited to the Reserve for Bad Debts. It is very easy to ascertain for income tax purposes the amount of bad debts actually sustained during the year by referring to the debit side of the Reserve for Bad Debts, and ascertaining the estimated allowance for bad debt by referring to the credit side of the Reserve for Bad Debts.

So the estimated normal overhead expenses will be charged into costs upon the particular cost method employed (man-hours, machine-hours, productive labor, etc.,) and likewise overhead expense will be debited to the particular expense accounts, and closed out periodically to the Reserve for Overhead. Accordingly, the debit side of the Reserve for Overhead will give the actual expense totals, and the credit side the estimated expense. It is assumed such a reserve for overhead will be sub-divided in accordance with departmental requirements, and where convenient the expenses will be scheduled.

The preceding has, moreover, left out of consideration refinements recommended by cost accountants of the principle of the Overhead Reserve, such as Under- and Over-earned Overhead or Burden, Overhead or Burden Variance, Supplemental Rates, etc. These do not disturb the essential principles set forth and are apt to confuse a simple presentation of them.

### Some Misunderstandings Clarified

Certain misunderstandings arise concerning the distribution of overhead expenses on the basis of normal year which should be mentioned and disposed of.

1. The setting up of estimated overhead charges based on a normal year does not mean the abandonment or compromising of actual overhead costs.

The actual expense exists alongside of the estimated and one is compared with the other differences analyzed and accounted for. To an executive such an analysis reveals the story:

(a) Of inefficiencies that must be eliminated;

(b) Of advances or decreases in costs not anticipated;

(c) Of costs artificially low or high because of sub- or abnormal production.

A cost system is built for service, not admiration, and must furnish information that will guide and temper the entire policies of an enterprise. At a time when more and not less business is needed, a cost system that literally interpreted, instructs an executive to refuse business except on prohibitively high and inflated costs of production, falls down when most needed. Such a system, though arithmetically correct, presents results that are misleading and which may work serious injury. Accordingly, the actual overhead charges are checked, corrected, supplemented and eased by the estimate of expenses based on the normal year.

2. It is not the intention to forego or wipe out a single dollar of overhead expense that can be legitimately and fairly charged to operation, sales or administration.

That the management should bear the expense of sub-normal production is a point that has been stressed altogether too exclusively. Meanwhile not sufficient emphasis is given to the converse; namely, that the management should be rewarded for abnormal production. One is as fair as the other.

The balance in the Reserve for Bad Debts is not customarily closed out to Profit and Loss at the end of the year, but carried forward into the next year's operations, since any one year may or may not be typical of the bad debts normally sustained. So likewise the production of any one year may or may not be normal, and the balance of the Reserve for Overhead, be it debit or credit, should accordingly be carried forward. If the estimate of normal capacity is reasonably low and cautious, such overhead expenses as have not been absorbed in one year will be absorbed and the losses recouped in the years of exceptional production, for in the long run the depth of the depressions will very nearly equal the height of the peaks.

### Found Feasible in Practice

What has been stated is elementary and suggestive. Its aim is to stimulate interest and encourage such changes as are necessary to meet progressive competition. The subject has been brewing for some time. It is referred to in the pamphlet of the Federal Trade Commission, "Fundamentals of a Cost System for Manufacturers," published in 1916, and to its development numerous well-known cost accountants and engineers have contributed. Upon inquiry of the Fabricated Production Department, establishments in such widely separated industries as paper, cutlery, envelopes, stoves, and metal products are operating on the basis of a normal year and upon this basis distributing overhead.

It will be useful to quote from the practice of one producer:—

"Our whole cost scheme consists in the first place, of a budget, made up the first of each year, for every department, machine and production centre. This budget must naturally be based upon past experience plus an intelligent estimate of the possibilities for the year. The hours of operation, or the production units are arrived at by taking an assumed 80% of possible operating time as a basis. In all these industries the standard week consists of forty-eight hours, or an eight-hour day. Deducting Sundays and holidays we assume that the year consists of three hundred working days of eight hours each, or 2,400 hours. We take 80% of this, or 1,920 hours, as our normal unit. This figure used in connection with our budget of expense and operation gives us our normal rate.

"We use this normal rate at all times in figuring both estimates and costs. Last year most manufacturers operated more than this normal, with a result that their actual costs were less than the normal cost, and this gain was taken as a sundry profit.

"At the present time the costs are running considerably higher than the normal, and for some time at least we must absorb this loss, maintaining at the same time a standard normal rate, but not subject to the violent fluctuations brought about by any increases or decreases in the volume of business handled."

But the number and percentage of establishments so operating is indeed inconsiderable and to many the mere idea of distributing overhead on a basis of a normal year is novel and daring.

### Normal Most Satisfactory Basis

The treatment of overhead in the way indicated is not a panacea for all our industrial ills. The control of overhead in a manner fair to the business man as well as the consumer is one step and only one step toward realizing more stable prices and eliminating those wild fluctuations that culminate in industrial depressions. Such a consideration also points out this moral, —that the hope of permanent reduction of costs rests only in the greater, more continuous and more regular use and operation of our industrial facilities.

Thousands of firms went through the recent years of full-blast operation upon a basis of overhead distribution essentially unfair to them. A start in the right direction must be made, and upon such firms is urged the consideration of adjusting overhead charges on the basis of a normal year, and it is so suggested, both as an advance in sound cost accounting and as a measure to facilitate that business revival we all desire, need and anticipate.

## Ontario's Toll Roads Disappearing

At eight o'clock Friday morning July 1st the last toll house in Ontario with one exception, passed out of existence. It is situated at the Belleville Bridge which crosses the Bay of Quinte from Belleville to Prince Edward county on the main road to Picton.

This road is now a part of the provincial highways system. It was recently purchased from a private company by the department of public highways, the city of Belleville and the county of Prince Edward, the province contributing $35,000, Belleville 30,000 and the county 20,000.

Toll was first levied on the road in 1890, when the bridge was built, at a cost of $130,000. It is of steel and rests upon stone abutments. It is 1,915 feet in length and consists of 17 spans, 13 spans of 100 feet each, 2 spans 150 feet each, one 60 foot span and one 240 foot swing span. The last-named is necessary because the bridge crosses the navigable channel.

It is anticipated that the freeing of the bridge from toll will encourage much farm traffic from Prince Edward county to the city of Belleville, which is the most important market and shipping point in that district.

When this road is opened the Sarnia-Florence plank road will be the last toll road in Ontario. It is in the county of Lambton, and runs southeast from the city of Sarnia. It is eleven miles long.

## Produce or Reduce?

In discussing present conditions and suggesting how business might be improved the manager of one woodworking plant puts it squarely up to his men, as follows:

Woodworking products are to-day being sold at prices varying anywhere from 25 to 50% below the prevailing prices of six months ago, and even at this reduction, there is only a small demand as compared with last year. What are we to infer from this condition? First, our finished product consists of labor and material, divided into almost equal proportions. The cost of material has been somewhat reduced—not, however, to the extent to which we have been compelled to cut our prices, whilst labor remains at its former high level.

Trade magazines and other publications have freely discussed the situation and suggested ways and means to reduce cost. Some writers advise greater production. Others, a substantial drop in wages. We cannot procure more for our goods and certainly cannot continue as at present, because, we are going behind every day. It is quite obvious that we must produce more or else submit to a cut in wages.

Do we do the same amount of work to-day as we used to do eight years ago? I say without the slightest hesitation that we do not, and further, we are falling short full 25% of our former standard, which means, that it now takes us five weeks to do what we once did in four weeks. If we can remedy this waste, then the problem will, to a large extent, be rectified. If, however, we cannot or will not do so, the only remaining alternative is by way of the pay envelope. Which shall it be—Produce or Reduce?

There is another way in which we can cut cost, that is by very carefully handling all material, taking great care to get the most out of everything that passes through our hands, and so reduce waste to a minimum. Were this to be done it would have a very marked effect on costs and perhaps on the volume of business secured.

## Hynes, Feldman and Watson Dissolve

Mr. J. P. Hynes, announces the dissolution of the firm of Hynes, Feldman & Watson, architects, Toronto owing to Mr. Feldman's death and Mr. Watson having joined Messrs. Warren & Wetmore, architects of New York City. Mr Hynes will continue practice with offices at 73 King Street West, Toronto.

# Automatic Sub-station for Toronto Transportation Commission

### One Thonsand Kilowatt Capacity installed, First of it's type in Canada. A Detailed Description of the Design and Operating Characteristics.

By H. C. Sutherland.

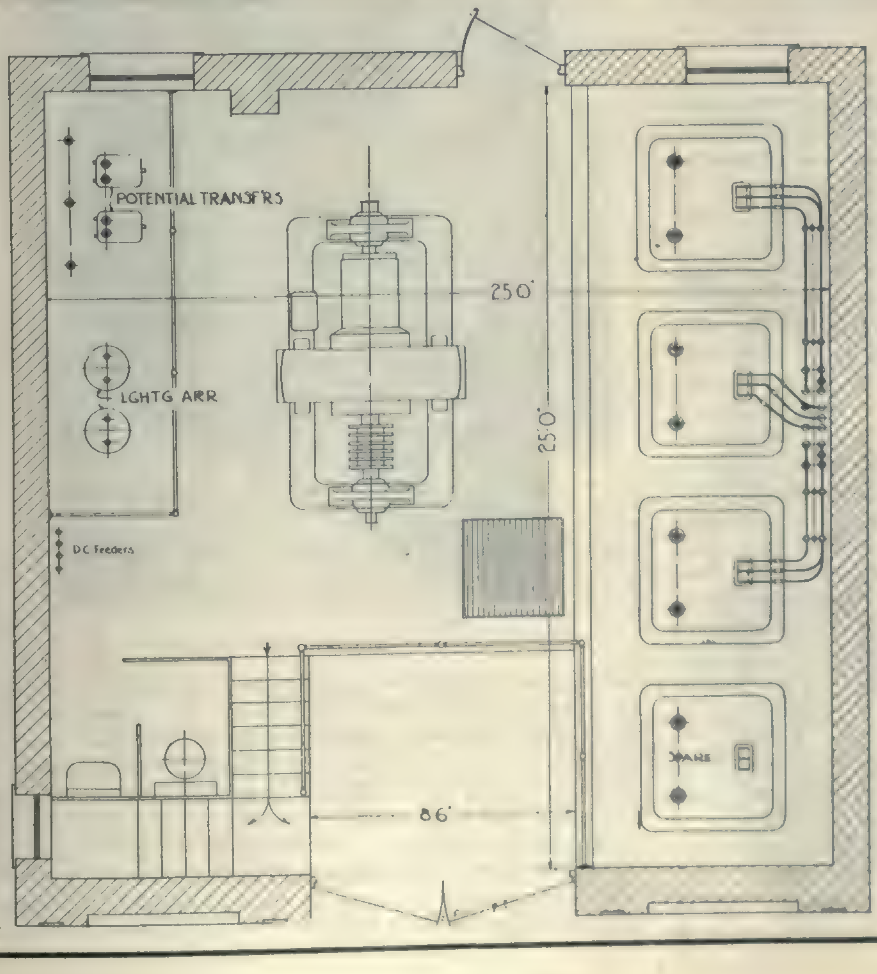
The rapid growth of the City of Toronto during the past few years has necessitated more adequate transportation facilities than those provided by the Toronto Street Railway and the city has been forced by the expansion of its suburbs into the building of civic lines on various streets for the convenience of those living at some distance from the centre of the city. On one of these, the St. Clair Avenue line, traffic density has grown to such an extent as to render more station capacity advisable and the Toronto Hydro-Electric System has recently installed a 1,000 k.w. automatic substation to augment the energy delivered from the High Level Substation at the System.

This new station is located at the corner of Ossington and Benson Avenues, one block south of St. Clair Avenue in a residential district. For this reason care has been taken to ensure an attractive building with adequate grounds. The walks are of buff pressed brick with cut stone trim, while the main floor and roof are of reinforced concrete slab construction on fire-proof steel beams. Owing to the relatively high cost of building at the time building operations were commenced, care was taken to keep the station size down to the smallest figure consistent with good design and arrangement of equipment. As actually constructed it is 25 feet square inside with main floor and basement, giving a volume of about 18 cubic feet per kw. of installed capacity. A crane is installed for the handling of the transformers and other heavy equipment. Construction and maintenance rooms are provided in the basement for the storing of supplies for these two departments, while lavatory accommodation is also available on the main floor.

## General Operating Features.

The term "automatic" as applied to a converter sub-station implies that all operations usually performed by station attendants are carried out by means of relays, contactors and other equipment in such a manner that no supervision is required beyond the visit of a maintenance man once or twice a week. No operators are required and operation is even more certain than when controlled by hand.

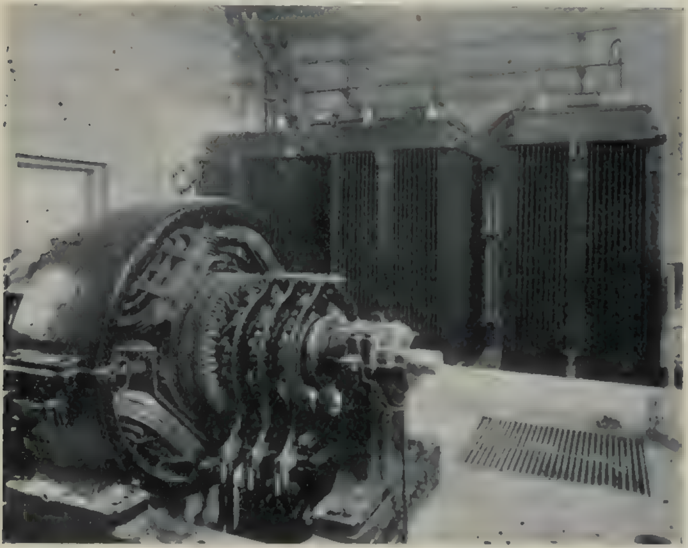
When a heavy load exists on the car line and trolley



Plan Showing Layout of Sub-station just completed for the Toronto Transportation Commission. A one thousand kilowatt Rotary Converter operating automatic.

voltage fails in consequence, the station will start up and will continue to run until such time as it is no longer needed and will then shut down. If required, it can also be controlled from a distant point, in this case the High Level station, by the operator stationed there, who can cut the station in or out as he pleases by the manipulation of the circuit breaker at his end of the line feeding it.

The general scheme of operation closely follows hand practice except that the judgment of the operator is replaced by mechanical features which function even more surely and rapidly than is possible manually. From the time the first relay operates until the station is in on the line is only about 35 seconds as compared with at least two or three minutes with hand operation. There is no possibility of error being introduced since, if a mistake should be made or some of the equipment fail to function the station will not start. Protective relays thus guard against every possible trouble due to operating or mechanical difficulties and in this respect the installation is even more completely protected than any manually operated station could be.



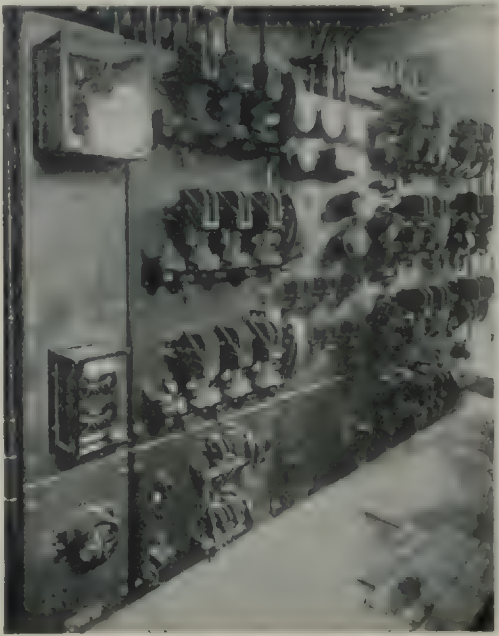
View of Interior, Automatic Sub-station, Toronto, showing Rotary and Transformers

In manual operation the operator first closes his starting switch before energizing the transformers, then see that his brushes are lifted, in a commutating pole machine, after which he throws in his oil switch. This latter impresses starting voltage across the converter and the machine picks up speed and swings into synchronism. During this period the voltage across the d.c. brushes is alternating, the periods becoming longer and gradually merging into a direct current potential as synchronism is approached. This potential may be either correct or reversed and the operator by manipulation of his field switch corrects for wrong polarity by reversing his fields, letting the voltage die down to zero and then, throwing the switch back again, catching the voltage in the right direction. After synchronism and correct polarity has been obtained, the starting switch is opened, the running switch closes, the brushes lowered and the machine is ready for placing on the line which is done by closing his main d.c. breaker.

The same sequence of events is gone through in this station, each step being controlled by the one preceding and taking place as soon as it is completed. Energy is received from the High Level station through a 13,200 volt transmision line together with a tap of the system's ring mains, thus providing two means of energizing the station. On a demand for energy being indicated by the closing in of contacts on a low voltage d.c. relay connected to the trolley ciruit, the station oil circuit breaker (type E-9) closes, energizing the rotary transformers. Four of these 400 kv.a. capacity and of the single phase type, are provided, the fourth acting as a spare in the event of failure in the operating bank. Previous to the transformers being energized and assuming everything to be correct, brushes up, no overheater bearing etc., the starting contactor is closed in and on the oil switch being closed the machine builds up speed and comes into synchronism.

Before the running contactors can be closed, polarity has to be checked and if necessary corrected. This is done by means of an engenious relay which tests polarity and corrects it when required and then opens the starting contactors and closes in the running.

It consists of a polarised motor having a permanent magnet field and a direct-current armature. This motor drives through reduction gearing, a drum contactor provided with four positions. The motor armature is connected across the converter commutator by means of pilot brushes. As the converter speeds up the voltage across the commutator is alternating and the relay motor armature merely tends to oscillate in consequence. As synchronism is approached the voltage merges into a direct current potential which may or may not be of the correct polarity. The relay armature then revolves in one direction or another depending upon polarity and turns the drum contactor. If correct polarity is obtained the order in which the contacts are engaged first drops out the starting contactor closes in the running contactor and then lowers the brushes. If, on the contrary the converter builds up with incorrect polarity the order of closing the relay contacts is reversed and the relay first energizes a small contactor from d.c. potential across polarity field contactor and throws in a similar one which reverses the fields. The d.c. voltage in consequence dies down and when it reaches zero potential the contactor which has just manipulated the field contactors, falls out and the field is again thrown back in its normal operating position. Polarity usually builds up in the right direction after this operation but should it fail to do so the same operation will be repeated three times, after which another relay will function to open the starting contactors and the machine makes a fresh start.



Control and Meter Board

After correct polarity has been obtained and the machine is on its runing taps, the brushes are lowered and the converter connected to the trolley bus through its main d.c. contactor and supplies energy to the line.

### Overload Protection.

Heavy overloads and short circuits are of fairly common occurrence on traction net-works and must be taken care of. Grid resistances are installed which can be put in series with each of the feeders and also the machine circuit. These serve to limit overloads to the two-hour rating of the machine and are also of service in putting the machine in on the line. For their protection under short-circut or overload conditions thermostats are provided which open the feeders or machine contactors and cut the station off the line. When the grids have cooled, the machine automatically comes in again and supplies energy as before.

Various other protective features have been incorporated into the control circuits, thus guarding against the usual troubles inherent in station work. For instance type C.O. relays are installed on the high-tension side of the transformers for short-circuit protection, the converter is equipped with thermostats which shut down the station consequent upon overheated bearings. An over-speed trip is also fitted to the rotary. These three protective features function through a lockout relay which prevents the station from starting up again until the trouble has been remedied and the relay is reset by hand. Reverse phase and low-voltage trouble is also taken care of.

The station is shut down through a current relay dropping its armature when current falls off to a predetermined value. This action operates another relay by means of which a time interval of between 3 and 30 minutes is interposed before shutting down takes place. By this means the stopping of a car will not affect operation nor will the station shut down through momentary fluctuations due to other causes.

The new Automatic Sub-station Exterior.

### Equipment.

With the exception of certain apparatus such as bus supports, potential transformers, etc. the equipment is of of Westinghouse make. The rotary converter is of 1.000 k.w. capacity and of their standard commutating pole type. It is located directly on the main floor no foundations being required. The switchboard is located in the basement and comprises four 2 feet 8 inch panels mounting the various contactors, relays and other control equipment, together with a metering panel upon which are mounted, a Westinghouse graphic wattmeter, a Bristol volt-meter (d.c.), a Lincoln demand maxicator and a watthour meter. These not only serve to meter the load but the graphic and recording meters also serve as a check on station performance.

### Design and Installation.

The engineering department of the Toronto Hydro-Electric System is responsible for station layout and design. The building was erected by Witchall & Son., contractors and the equipment in general is of Westinghouse make. the installation of equipment except for high-tension and metering, being done by the Canadian Westinghouse Company.

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Professor Charles A. Ellis, of the University of Illinois, has resigned to become vice-president of the Strauss Bascule Bridge Company of Chicago. Professor Ellis is a graduate of Weslayan University. For two years he was assistant to the city engineer at Middletown, Connecticut. From 1902 to 1908 he was employed by the American Bridge Company as draughsman checker, squad foreman, and designer on many large railway structures. From 1908 to 1912 he was assistant professor of civil engineering at the University of Michigan, and from 1912 to 1914 designing engineer for the Dominion Bridge Company. In 1914 he was made assistant professor of civil engineering at the University of Illinois and since 1915 has been professor in charge of all courses in bridge and structural engineering. Professor Ellis has been a constant contributor to the technical press, and is now completing the manuscript for a text book on Framed Structures, which will go to press this autumn. He has recently been appointed one of the associate editors for a large and comprehensive library of hand books in structural engineering.

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THERE ARE TWO KINDS OF BUSINESS MEN

By ALBERT T. REID

DARN'D IF I'LL SPEND ANY THING TO BE PULLED OUT ... STAY HERE ... THE ROAD ... DRY
HOW WE'RE GETTING OUT!
ENERGY
BUSINESS
BUSINESS DEPRESSION
Albert T. Reid

Reprinted from New York Evening Mail.

# NEWS OF CONTRACTS

## Period of July 6 to July 12, 1921

***Dominion Wide Service Exclusive to "Contract Record & Engineering Review"***

### Waterworks, Sewerage and Roadways

**Antigonish, N.S.**

C. D. Chisholm, Antigonish, has general contract for construction of 3.71 miles gravel road for Prov. Govt. Dept. Pub. Highways.

**Kingsville, Ont.**

Town Council plans to make extensions and improvements to water works to cost $15,000. R. W. Code, Engr., 14 London St. W., Windsor, Ont.

**Kingsville, Ont.**

Construction of filtration is contemplated by Town Council. W. G. Long, clerk.

**Lloydminster, Alta.**

H. S. Carpenter, Deputy Minister Dept. of Highways, Prov. Govt., has plans and will reecive tenders until July 25th for providing necessary equipment and labor for construction of earth road. Plans with J. R. Reid, Swift Current; Wm. Grant, Saskatoon; F. G. Kissack, North Battleford. Accepted cheque for $800 payable to Deputy Minister, or Guarantee Company's bid bond must accompany each tender.

**London, Ont.**

S. Baker, City Clerk, will reecive tenders until July 21st for construction of sewage force mai.n. Plans with Engr., H. A. Brazier.

**Montreal, Que.**

Administrative Commission will receive tenders until July 18th for asphalt paving and concrete sidewalks on Girouard Ave. to cost $33,340 for City. Plans with A. E. Doucet, Engr.

Construction of water main from Montreal to Verdun is contemplated by City A. E. Doucet, Engr.

**Niagara Falls, Ont.**

W. J. Seymour, clerk, will receive tenders until July 25th for construction of trunk sewer estimated to cost $250,000 for City. Plans with Mr. Jepson, Engr., Niagara Falls, Ont., and Consg. Engrs., James Proctor & Redfern, Ltd., Excelsior Life Bldg., Toronto. Bid bond will be required with each tender.

**Amherstburg, Ont.**

#### CONTRACTS AWARDED

General contract for concrete sidewalks for Anderson Twp. Council is awarded to Pettypieces, Ltd., Amherstburg.

**Courtenay, B.C.**

Contract at $30,000 for wire wound wooden pipe required for water works costing $73,700 for Courtenay Council, is placed with Pacific Coast Pipe Co., 1551 Granville St., Vancouver. Contract for other iron work, etc., is awarded to Terminal City Iron Works, 1949 Albert St., Vancouver.

**Glencoe, Ont.**

General contract for construction of pavement costing $15,000 for Town is awarded to Archibald Construction Co., 122 Delaware Ave., Toronto.

**Montreal, Que.**

John P. Hefferman, 214 Bishop St., is aawrded general contract for construction of sewer on one street costing $24,360 for City.

General contract for construction of sewer on one street costing $11,295 for City is placed with J. Toussaint Sr. 3044 St. Denis St.

Duranceau & Duranceau, 152 Hamilton St., have general contract at $15,941 for asphalt paving on one street for City.

Council awarded general contract for construction of permanent pavements and sidewalks on two streets costing $15,265 to Quinlan, Robertson & Janin, Ltd., 50 Notre Dame St. W.

**New Glasgow, N.S.**

General contract for construction of 7.85 miles gravel road for Prov. Govt., Dept. Pub. Highways, is awarded to D. J. & F. N. Fulton, Merigomish, N.S.

**St. Mary's, Ont.**

Contract at $15,000 for additional work for construction of permanent pavement for Council is awarded to Curran & Briggs, 51 Rusholme Park Cres., Toronto.

**Swift Current, Sask.**

General contract at $17,218.80 for construction of highway for Prov. Govt., Dept. of Highways, is placed with T. C. Hare, Swift Current.

**Winnipeg, Man.**

General contract for construction of drains and drainage for Prov. Govt. is awarded to E. W. McLean, Arlington & Alexander Sts., Winnipeg.

### Railroads, Bridges and Wharves

**Edmonton, Alta.**

J. D. Robertson, Deputy Minister Dept. Pub. Works, Prov. Govt., has plans and will receive tenders until July 30th, for construction of several steel highway bridges.

**Port Stanley, Ont.**

London & Port Stanley Ry. Bd. plans construction of three railway sidings at cost of $20,000.

**Poupore, Que.**

R. C. Desrochers, secy. Dept. Pub. Works, Dom. Govt. Ottawa, will receive tenders until July 26th for construction of piers. Plans with Dept., Ottawa, Dist. Engr., Shaughnessy Bldg., Montreal, and Post Office, Poupore.

**St. Honre ,Que.**

Town is constructing reinforced concrete bridge at cost of $12,000.

**Westbridge, B.C.**

Tenders will be called shortly for construction of concrete piers and wooden bridge for Prov. Govt.

#### CONTRACTS AWARDED

**Ioco, B.C.**

General contract for construction of wharf at cost of $10,000 for Dom. Govt., Dept. Pub. Works, is awarded to R. Bumstead, 420 21st Ave. E., Vancouver.

**Ottawa, Ont.**

Carleton County Council awarded general contract for construction of bridges Nos. 1, 2 and 3 to H. Kennedy, Torbolton Twp., Ont., and for No. 4 to Ontario Bridge Co. Ltd., Crown Bldg., Toronto.

**Shawinigan Falls, Que.**

General contract for construction of bridge costing $20,000 for C. N. Rlys. is placed with Brig. Gen. Harvey, Room 310, 137 McGill St., Montreal.

**St. Alexis de Matapedia, Que.**

Chas. Lamb, Chandler, Que., is awarded general contract for construction of bridge costing $46,500 for Municipal Council. Steel contract is placed with MacKinnon Steel Co., Ltd., Drummond Rd., Sherbrooke, Que.

**St. Germain de Grantham, Que.**

Steel contract for steel and concrete bridge costing $14,500 for Municipal Council is awarded to MacKinnon Steel Co. Ltd., Drummond Rd., Sherbrooke, Que.

**St. Philippe, Que.**

General contract for construction of steel and concrete bridge costing $11,000 for Municipal Council, is placed with Eugene Longtin, St. Philippe.

**St. Luc, Que.**

Victor Durand, Gentilly, Que., has general contract for construction of steel and concrete bridge costing $26,100 for Municipal Council.

**St. Roch des Aulnaies, Que.**

Z. Cloutier, St. de Montmagny, has general contract for construction of reinforced concrete bridge for Municipal Council.

### Public Buildings, Churches and Schools

**Burnaby, B.C.**

Bowman & Cullerne, architects, 716 Yorkshire Bldg., Vancouver, are preparing plans for addition to school to cost $12,000 for Burnaby School Bd.

**Corbin, B.C.**

Plans are being prepared for addition to school for Prov. Govt., Dept. Pub. Works. H. Whittaker, architect, Parliament Bldgs., Victoria.

**Delburne, Alta.**

Erection of hospital is contemplated by Municipality.

**Essex, Ont.**

S. W. ohnston, Sec. High School Bd., will receive bulk and separate tenders until July 15th for erection of High School to cost $90,000. Plans with J. C. Pennington, architect, Bartlett Bldg., Windsor.

**Eston, Sask.**

D. Webster, architect, C.P.R. Bldg., Saskatoon, is preparing plans for addition to school for Eston S. D.

**Ham Sud, Que.**

School Bd. plans erection of two schools. O. Lamoureux, Sec.-Treas., Ham Sud, Que.

**Huntingdon, Que.**

Erection of Registry Office is contemplated by Council.

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## *Research Associations Are Invaluable Adjuncts to Industry*

The movement for research along industrial lines has made great progress in the British Empire since the termination of the war. It was in 1916 that the British Government decided to appoint a Department of Scientific and Industrial Research for the purpose of bringing scientific knowledge into intimate relationship with industry. This was considered necessary, as it was evident that some steps was imperative to enable British manufacturers to hold their own against the increasingly keen international competition of modern times. Work of this nature had been carried out in the United States and in Germany for several years, particularly in the latter country, and much of their industrial progress must be credited to their well-organized research policy.

The British Government therefore established various research associations in close co-operation with the various industries of the country, consisting of the firms engaged in each single industry, or in a group of industries, and £1,000,000 was placed at the disposal of a research department, out of which grants were to be made to promote research associations, the principle generally adopted being that if an association guaranteed to raise from its own members a certain minimum income for five years the department would pay pound for pound up to a fixed limit. The success of this government scheme is well illustrated by the fact that already twenty-six industries have applied for the government grant and formed themselves into as many research associations. These associations include the larger industries in the country, such as glass, electrical, wrought iron, refractories, non-ferrous metals, Diesel engines, motors, cutlery, scientific instruments, linens, cottons, woollens, photography, and now we have a report of the formation of a Cast Iron Research Association. The work of this latest association will include the investigation of problems arising in the manufacture of pig irons, grey iron castings, malleable iron castings, semi-steel castings, chilled rolls, cast iron, hollowware, cast iron pipe, light castings, etc., in such a way as to cover and include all branches of the cast iron industry. All these, and other subsidiary operations as they crop up, will be dealt with by the Cast Iron Research Association, either directly or in collaboration with other research bodies.

It must be evident to all that the work of these associations promises very valuable results for British industries. Successful and economical production of these materials is very intimately bound up with questions of melting, annealing, furnace design and construction, refractory materials, molding sands, the economic utilization of fuel and the engineering aspect of foundry work. The formation of the last-named association seems to be one of the most important steps that has yet been taken because there is probably no material which is more essential to our modern civilization than cast iron.

## *Curing the Accident Epidemic*

The death toll during the past few weeks owing to so-called accidents has been something tremendous, yet looking back over them there doesn't seem to be a single case where the fatality or the "'accident'' was not preventabe. A collision on a city street between a motor car going at 45 or 50 miles an hour and a milk wagon is not an accident—it is merely murder or suicide, depending on whether the occupant of the milk wagon or the occupant of the motor car is the victim—yet what punishment does the law provide in such a case?

What is the use of making innumerable laws regarding traffic regulation and taxing the citizens heavily to maintain a police force to see that these laws are carried out, if such things can be done almost daily The laws so far framed seem to be made chiefly to catch the unwary citizen who once or twice in a lifetime steps on his accelerator instead of his brake, and thus exceeds the limit by a couple of miles an hour until he realizes his mistake. The law seems to be made for the average citizen, when as a matter of fact the average citizen is law-abiding, careful and considerate of others as well as himself, but it does not reach drivers who are the real menace to public safety.

It is a reasonable presumption that a law is not right unless it prevents the offense. In the old days sheep stealing was so common that hanging was eventually made the punishment for this crime. That stopped sheep stealing. Motor theft has become so common that the punishment has been made a year's imprisonment. If the law is carried out that should stop motor thieving; but if not, the punishment should be increased. The present law, and the present means of enforcing the law, have not succeeded in preventing speeding, particularly at night. We see very little difference betwen knocking a man out of a milk cart and killing him and meeting him suddenly on a street corner and shooting him—the net result is the same. Why should 99.9 per cent. of our citizens have to approach every street corner with bated breath lest some

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foolhardy motorist should shoot across our path and remove part of our anatomy or the front half of our motor car?

This same thing applies in a greater or less degree to those who take chances in small boats and canoes when they are not able to swim. Here again the law is an anomaly. If a man who cannot swim throws himself off the wharf into the water he is immediately taken in hand by the police, hailed to court and punished as a would-be suicide. If he hires a canoe, however, loads two or three other non-swimmers into it, paddles out into the night and fails to return it is a much-lamented accident; yet where is the difference? We seem to have reached the stage in our civilization when men should not be allowed to perform any foolhardy act which may result disastrously to others or to themselves.

# Houses Wanted; Rents Ascending; No Building—Will Labor Concede 10 Per Cent?

An important conference of the building industry was held in the Board of Trade rooms, Toronto, on Thursday, July 14. The delegates included some nineteen representatives of the different labor organizations, as well as representatives of the general contractors, sub-contractors, manufacturers, supply houses, architects and Board of Trade. The object of the conference was to discuss and determine, if possible, some means of hastening the revival of activities in the building and construction industry, the feeling underlying the whole movement being that if building could be undertaken now and unemployment taken care of, other phases of our idustrial life would automatically derive beneficial results.

Senator Gideon Robertson, Minister of Labor of the Dominion Cabinet, presided, and, by his very fair and deliberate attitude towards the whole question, was responsible for harmonizing the various interests represented. Senator Robertson produced some very interesting figures regarding the cost of building materials, of labor, and of the cost of living. He pointed out that labor costs on this continent are considerably higher than in other parts of the world. While he had no desire to see the standard of living of our workers reduced, still the fact that we must compete in the world's markets was a factor that must be considered. There was no doubt but that the cost of living had fallen. "Rents" was the only item that had not given way, and in this case, as in others, it was a matter of supply and demand. The unemployment, which was causing so much distress and making it so difficult for the working man to pay his rent, was the direct result of the shortage of houses which ought to be building at the present time, and thus take care of the unemployment.

The Senator urged again and again that something must be done to satisfy the public that house building is a safe investment at the present time. To this end it seemed necessary that everybody, from the manufacturer down, should make some sacrifice. In this connection he pointed out that the prices of building materials had already receded. An average of forty-two of these items showed that whereas the percentage of increase above normal ros as high as 184 per cent. in 1920, this percentage had now dropped to 118 per cent The cost of living had fallen a little over 20 per cent., and stands now only 63 per cent. above 1914. Labor, in the building trades in Toronto, was practically the only item entering into the cost of construction that had not been reduced and, incidentally, the building industry was practically the only one of all our industries that had not arbitrarily reduced wages. In view of this, it seemed only fair that labor should take cognizance of the reductons in other directions and make concessions of 10 or 15 per cent. in the hope that this would induce a quantity of building. Here again Senator Robertson urged that the workers may easily be money in pocket at the end of the season as the result of the larger number of hours they would be employed, though the rate of wages might be slightly less.

The discussion brought out very clearly another point which should receive the attention of the building trades, namely, the importance and handicap of the present high freight rates on building materials. For example, it was pointed out by a brick manufacturer that his freight rates on coal were to-day greater than the freight rates and the cost of the coal put together in 1914. Of the two resolutions adopted by the conference, therefore, one referred to freight rates, the other to labor, as constituting the two features at the present time exerting the greatest influence on the building depression.

Briefly, these two resolutions were as follows:

Resolution re Freight Rates: This cited the handicap placed upon the building industry by the present high freight rates on building materials, many of which are very heavy in weight in proportion to their value, so that the cost of transportation constitutes a very large percentage of the ultimate cost of the material, and it urged the appointment of a committee, representing the various interests present at this conference, who would prepare a memorandum on this subject and present it by deputation to the Dominion Railway Board..

Resolution re Wages: This resolution pointed out the fact that the cost of living had fallen and was falling; that the cost of building material had been greatly reduced and that these prices were still on the toboggan, and expressed the opinion of the conference, including labor, that the arguments brought forward during the day should be transmitted by the labor delegates to their various constituents with the recommendation that a reduction of ten cents an hour from the present labor scale be put into effect on July 25th. This resolution also urged manufacturers and supply houses to do everything in their power to further reduce their prices.

A further meeting will be held in the Builders' Exchange on July 25th at 10.30 a.m. to receive the final answer by the various delegates.

# Winnipeg's Newest Theatre—The Garrick

## A Recently Completed "Movie" that is the Latest Word in Playhouse Design and Construction—Ramps Supplant Staircases

The new Garrick Theatre, Garry Street, Winnipeg, recently completed, is one of the most up-to-date moving picture theatres yet constructed. It is so designed that the large audience provided for, is accommodated with absolutely no loss of space by irregularity of plan or unnecessary architectural features. It is rectangular in plan, 79 feet wide by 120 feet deep, accomodating an audience of 1300, including 100 in loge seats. The floor is inclined with a gradient of 2 in 11, which enables every one of the audience to obtain a clear and uninterupted view of the screen..

The auditorium of the new Garrick theatre, Winnipeg

A special feature of construction is the manner of ascent from the entrance to the auditorium which is by means of inclined aisles, one on each side of the auditorium; there are no staircases, the aisles are sufficiently wide and of such easy grade as to permit of free access or exit without overcrowding or possibility of jambing in the case of a panic.

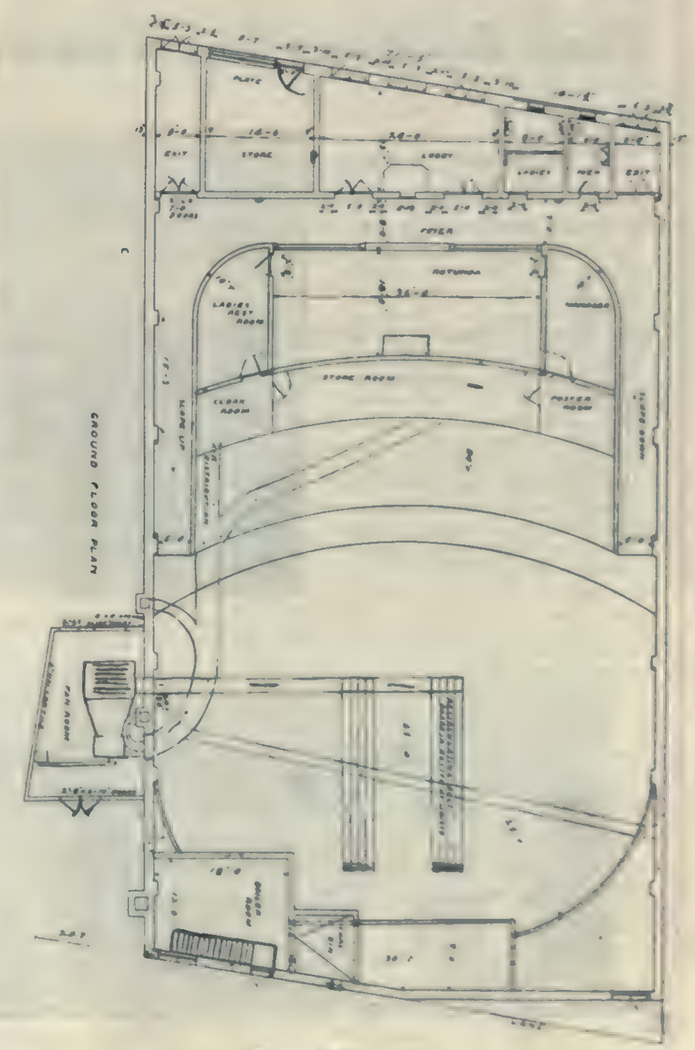
The building was erected and is owned by well-known local business men, and is under the very capable management of Mr. W. P. Wilson, one of the largest shareholders, and a man with extensive business experience of this particular class. The plans and specifications were prepared by Melton Bretts, also a shareholder in the company and who is now acting as the chief projectionist of the theatre.

All the materials used in the construction were obtained locally, as was also the labor employed throughout the whole work. A. A. Simpson, Winnipeg, was the general contractor and John Senior, superintendent of construction.

The walls are of sand-lime bricks, with Tyndal limestone dressings.... The bricks were manufactured and supported on steel lattice girders 77 feet long, suplied by the Dominion Bridge Co.

The operating room is of steel and reinforced concrete, and is situated at the extreme end of the building, the distance from operating machine to screen being 110 feet. A luxuriously furnished lounge room, 14 ft. by 36 ft., is cnveniently located near the entrance. The electric lighting was done by the Schumacher-Gray Co., Winnipeg. It is of the indirect x-ray type, and is a distinctive feature of the interior, the entire illumination being concealed in specially built recessed corbels. Particular attention has been given to the ventilation and heating systems, with a view of ensuring comfort during any season of the year and at a minimum cost of operation.

The decoration is of a soft and pleasing tone



Ground floor plan

throughout the whole building, and is of a style very appropriate for the kind of building. All decorations were executed by the Taylor Decorating Co., Winnipeg.

The Windmill Point quarries of the Standard Crushed Stone Co., Ltd., Niagara Falls, Ont., have been leased by Mr. E. G. Law, the well-known Toronto contractor, who has overhauled the plant. Windmill Point stone enjoys a wide reputation as road metal, and Mr. Law proposes to use practically the whole output on his road contracts in the county of Welland

The Ontario Safety League, whose convention was held in April last, has now had the various papers printed and they are ready for distribution in booklet form. This booklet not only contains information in which every man, woman and child in Canada is interested, but it also contains entertaining reading matter. The articles are of a general nature, but have special relation to the safety features of industrial plants.

As pointed out in a recent issue, Mr. R. B. Morley has withdrawn his active connection with the association in order to take up other work, and Mr. J. F. H. Wyse has been appointed general manager. Mr. Wyse is widely known for his enthusiasm in the work of the Safety League, and the continued usefulness and efficiency of this organization is assured under the new management.

The engineering firm of Barber, Wynn-Roberts & Seymour state that the date for receiving tenders for concrete pavement in the town of Paris, Ont., has been extended from July 23rd to July 30th.

A report from Revelstoke, B.C., states that there are no new building being erected at the present time, the only construction work being on roads and bridges by the provincial government. The roads are being completed by contractors who have been doing work for the government for a number of years.

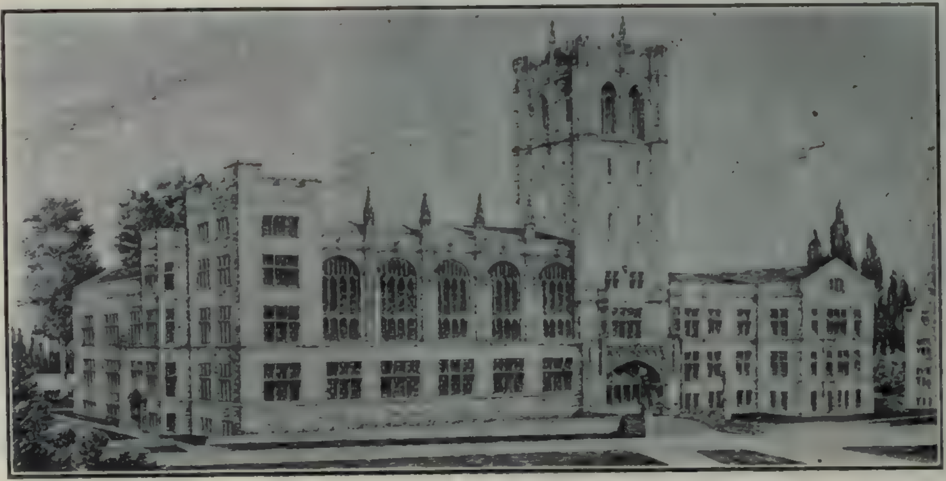
Mr. Gordon F. Perry, president and general manager National Iron Corporation, is on a visit to England in connection with the proposed manufacturing plant in Canada of the English Electric Company, Limited

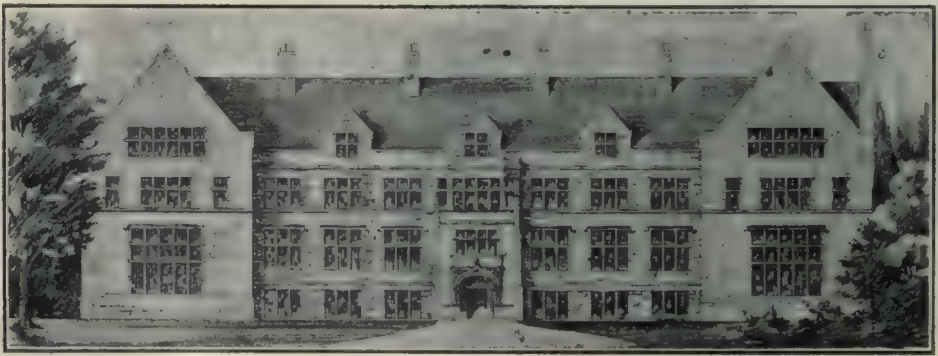
The Montreal building permits for June totalled $2,499,159, an increase of $58,224. For the half year the value was $7,420,178, a decrease of $1,134,066.

# New Buildings for Western University, London, Ont.

## The Main Arts Building

This is 220 ft. long, with two wings, each 130 ft. deep. There will be over 60,000 sq. ft. of floor space. The plans contain a Memorial Hall to Middlesex soldiers and nursing sisters; offices of the president, treasurer and registrar of the university, and of the dean and other officials of the College of Arts; 10 offices for heads of departments; 20 class rooms; library; reading room; assembly hall; board room; faculty room; cloak rooms; cafeteria and storage rooms.





## Natural Science Building

This is 195 ft. long, with two wings, each 130 ft. deep. The offices and laboratories of the departments of chemistry and physics will occupy the first floor. The second floor will be given over to the department of biology, while on the third floor will be geological museum, and laboratories.

## Public Works in Montreal Being Neglected, Says Mr. Doucet

Some very pertinent remarks regarding the neglect of public buildings are made by Mr. A. E. Doucet, Director of Public Works for the city of Montreal, in his annual report for 1920. The dilapidated appearance of public buildings in Montreal is due, says Mr. Doucet, to lack of funds. No moneys, or at least very little, have been appropriated for repairs for years, the consequence being the dilapidated state of the buildings caused by years of neglect.

"Such an unwise course of want of maintenance will necessitate an annual expenditure of $100,000 to $150,000 for a period of five years, when we might expect to have our buildings safe and wholesame to live in, and pleasant to view, instead of the eyesore they now are."

### A Comprehensive Sewerage Scheme.

Mr. Doucet states that the necessity of a broad and comprehensive plan for a main sewerage system is increasingly felt as time goes on. The main sewers should be left to an independent commission, if the city wishes to secure efficiency and continuity. "I have had the honor to suggest to your commission that this work should be entrusted to the Water Board of Montreal, whose staff is fully qualified for the work. The designing of water mains necessitates a correct contour map of the whole city and environments, and this same contour map is also an absolute necessity before we can decide on the accurate location and design of our main sewers. Had this policy been carried out years ago a good many of our main sewers would not now be useless. As the Water Board is charged with the duty of working out a proper and efficient water supply, it is reasonable to claim that its disposal should also be entrusted to its care."

Montreal is urgently in need of incinerators, the garbage being at present deposited in unused quarries. Mr. Doucet suggests that two large plants be constructed; one of these should be installed at once at a cost of from $250,000 to $300,000.

## Contractors at Work on First Unit of Wales Home, Richmond, P. Q.

The first unit of the Wales Home, Richmond, P.Q., is now under construction from plans by Mr. Harold Lawson, Montreal. The home is for indigent aged people of both sexes, and is made possible by a legacy left by the late Horace P. Wales and a campaign for funds recently held in the Eastern Townships. The initial accommodation is for forty people; other buildings will be erected as necessity arises.

The building is approximately 130 feet long, with an average width of 40 feet. It has a high basement and is two storeys in height, except for the central portion which rises one storey higher. The construction of the exterior walls to the ground floor level is of concrete, all other walls being of Laprairie plastic brick for facing and Richmond brick for backing and interior work. There are two interior fire walls of terra cotta. Otherwise the construction inside consists of steel and wood. Except for the central portion, which will be covered with a hipped roof and asphalt shingles, the roofs are flat; covered with felt and gravel.

The basement contains a large kitchen, pantry, refrigeration and storage rooms. It also contains a hot water heating plant, laundry, a room for an orderly, toilets, and other general service rooms. The ground floor consists of living-rooms, dining-room, a parlor for visitors, a matron's office, cloak rooms and toilets, and sleeping accommodation for ten. The first floor contains sleeping quarters for inmates, with exceptionally liberal toilet facilities. This floor also has a matron's and a nurse's room. The servants' quarters are on the top floor.

The general contractors are the Newton-Dakin Construction Company, Limited, Sherbrooke. The steel is being supplied by the MacKinnon Steel Company, Limited, Sherbrooke.

## Construction in Montreal District Shows Substantial Improvement

Construction in the Montreal district is increasing, and with the recent reductions in prices may be expected to show a substantial expansion. The fact that some very large contracts have recently been awarded would warrant the conclusion that investors have come to the conclusion that costs have about reached a stable basis. Labor is abundant, and can be obtained at figures below what has been set as a standard by the unions.

The contracts recently closed include the Mount Royal Hotel, two ten-storey buildings, extensive additions to McGill University, a very large clubhouse, and several schools and churches. A feature of the season so far has been the very large number of residences and apartment houses erected, but the needs of the community are still far from filled.

The reports from the Province show that a considerable amount of building is now proceeding, the chief work being on churches, convents and schools.

## Prominent Engineers Entertained by Sault Ste. Marie Branch, E. I. C.

Mr. J. M. R. Fairbairn, chief engineer of the Canadian Pacific Railway Company, and Mr. Fraser S. Keith, secretary of the Engineering Institute of Canada, were entertained by the Local Branch of the Institute at the Sault Ste. Marie Country Club on the evening of June 28th. The other guests were prominent men in the larger industries centred here, and legal and municipal dignitaries. The speakers were Mr. J. M. R. Fairbairn; Mr. W. C. Franz, president of the Algoma Steel Corporation; Judge F. Stone, Crown Attorney; G. W. Goodwin, Mayor Farquhar, Mr. C. C. Irvine and Mr. F. S. Keith. Mr. Fairbairn, who is president of the Engineering Institute of Canada, and an authority on steel rails of world-wide repute, gave some facts in connection with the new standard "100-pound" rail lately adopted by the Canadian Pacific Railway, and which is now being rolled by the Algoma Steel Corporation to a very exacting specification for the first time in Canada. The part that engineers have played in the development of the great industries, railways, ship canals and waterpower developments in and adjacent to this city were acknowledged, and a great future indicated for the engineer, and his unusual qualifications for public service were noted by the various speakers.

# Sales Tax Applied to Lumber

### Canadian Lumbermen's Association Explains How Tax is Determined for Transactions in Rough and Milled Lumber

The Canadian Lumbermen's Association have recently issued a circular to members outlining the application of the sales tax to dealings in lumber and products. For the benefit of contractors, this information is passed on herewith:

On Saturday, May 21st, an amendment to the changes in the sales tax so far as lumber is concerned, which came into operation midnight May 9-10, 1921, reduces the amount of the tax from 3% to 2%. The effective date of the present resolution dates back to May 10, 1921 on and after which date the manufacturer will be called upon to pay to the government 2% on the amount of his sale. The manufacturer must furnish the purchaser with a written invoice of the sale, which invoice shall state separately the amount of taxto at least the extentof1½%. (This means that the manufacturer may absorb not more than one half of 1% of the tax.) He must not include in his invoice price any portion of the tax. It is specifically provided in the resolution that the tax shall be payable by the purchaser to the manufacturer at the time of such sale. This means that the tax will be payable when the goods are shipped and invoiced to the buyer,(See separate paragraph regarding pro formas). After the payment of the tax payable by the manufacturer there is no further tax payable on resale.

The term, "lumber" includes the product of logs either rough lown or dressed, flooring, siding, ceiling, and products of like nature wherein the essential character of the product is not changed into the whole or part of some specific article of remanufacture, such as furniture, wagons, sash, doors, etc.

Lath, shingles and pickets are considered as lumber.

Box shooks of rough or planed lumber cut to various lengths and width come under the heading of lumber.

Poles, pulpwood and posts are in the nature of logs and round timber and are exempt from taxation.

Shavings and sawdust being waste products are classed as fuel of all kinds and are exempt from taxation.

With regards to lumber paid for on pro forma invoice prior to May 19th, 1920 and up to and including manufacturer's yard at the risk of the buyer no tax is to be paid.

On sales of lumber paid for on pro forma invoice commencing May 19, 1920, and up to and including midnight of May 9th, 1921, but not shipped until on or after May 10th 1921, if stored in the manufacturer's yar at buyer's risk there is no tax of any kind.

On any sales, commencing midnight, May 9-10, 1921, the tax of 2% is to be paid by the manufacturer and he must charge not less than 1½% of this tax on his invoice, as above stated, and collect same from the purchaser.

In the case of a saw-mill having a planing mill in connection therewith or even if the planing mill if situated at a considerable distance from the saw-mill, where the lumber is simply transferred from one department to another the tax applies on the invoice value of the lumber, (product of such planing mill) as sold and shipped. That is to saym, there is no sale of the lumber to the planing mill and consequently the price of the finished lumber is the criterion on which to base the sales tax.

As there is no further tax on resale after leaving the manufacturer's hands it is only necessary for the manufacturer in respect of lumber to take out a license.

The information contained in this paragraph was amended by a supplementary circular which stated:

The Department of Customs and Inland Revenue, took up with us the question of sales tax on lumber bought and paid for on pro forma invoices between May 19th, 1920, and midnight, May 9-10, 1921. According to the first rulling as per our circular (printed above) there was to be no tax on such transactions. A reconsideration of this point by the Department has resulted in a change.

The new ruling is: "On sales of lumber paid for on pro forma invoice commencing May 19th, 1920, and up to and including midnight of May 9th, 1921, but not shipped until on or after May 10th, 1921, if stored in the manufacturer's yard the tax will be 1% on shipment to a Canadian destination, and there will be no further tax on resale."

This 1% must be billed forward with the shipment and collected by the manufacturer from the purchaser.

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# Canadian Association of Master Painters and Decorators Meet

The Canadian Association of Master House Painters and Decorators held their 17th annual convention in Ottawa on Tuesday, Wednesday and Thursday, July 12, 13, 14, with headquarters at the Chateau Laurier. The program included some very interesting topics, such as "Some Treatments for Cypress," by Mr. W W. Bamlett, president of the Toronto Association; "The Ideal Master Painter," by Geo. T. Green, Ottawa, second vice-president of the Canadian Association; "Graining," a practical demonstration by Messrs. Ben Goodfellow of Galt and Wm. Laidlaw of Hamilton; "White Lead: a Vital Necessity of the Pointing Business," by Messrs. John Dewar of Pittsburg and John R. MacGregor, Chicago; "How to Turn a Dead One Into a Live Wire," by Fred T. Brooks, Hamilton, first vice-president of the Canadian Association; "Character," by W. E. Wall of Somerville, Mass.; "Selling the Principles of Your Business," by Mr. Andy Hay. There was also scheduled a lecture by H. A. Gardner of Washington, D.C., and a demonstration of blending and stippling in colors. "Ancient and Modern Methods of Estimating," was an interesting topic well handled by W. Bavington of Toronto. Mr. Bavington quoted from a recent issue of The Contract Record, and spoke very highly of the system of estimating that had been outlined there.

Another feature of the convention was an address by Mr. James Phinnemore, Toronto, president of the International Association.

Mr. H. Weatherwax, Tillsonburg, is this year's president, and Mr. William Paris, 270 Wellesley Street, Toronto, is secretary-treasurer.

## Western Convention of Professional Engineers, Aug. 10-12

The Western Professional Convention of the Engineering Institute of Canada, will be held at Saskatoon, Wednesday, Thursday and Friday, August 10th, 11th and 12th. A special feature of the convention will be a regular meeting of council at which it is expected that the majority of the Western councillors will be present and to which the travelling expenses of one councillor from each province will be paid by headquarters. This meeting will afford an opportunity of a discussion of Western problems. The program for the convention is as follows. This is, however, only tentative and will be enlarged and possibly altered.

**Wednesday, August 10th—Saskatchewan Branch**

Morning Session—
- Reception and Registering.
- Opening Address by President of the Engineering Institute of Canada.
- Development of Trunk Highways as effecting the Western Provinces, by C. W. Dill, including report of Committee on Standard Specifications for Highways asked for in 1918.

Afternoon Session—
- Concrete Research, by Pro. C. J. Mackenzie, M.E.I.C.
- Telephone paper, by W. R. Warren.

**Thursday, August 11th—Alberta Branches and Winnipeg Branch**

Morning Session—
- Water Supply and Irrigation Schemes as affecting the three Prairie Provinces, by G. N. Houston, M.E.I.C., Calgary, assisted by A. J. McPherson, A.M.E.I.C., Regina.
- Coal Fields of the four Western Provinces.
- Bricquetting of Lignite and Fuel Economy, by R. DeL. French, M.E.I.C., and Wm. Pearce, M.E.I.C.

Afternoon Session—
- Water Power and Electrical Transmission Systems, Messrs. J. M. Leamy, M.E.I.C., and C. H. Attwood, A.M.E.I.C.
- Possibilities of the Unexplored Northern Portion of the Western Provinces, including Transportation, by Dr. Wallace, Commissioner Northern Manitoba.

**Friday, August 12th—General**

Morning Session—
- General Welfare of the E.I.C., including Legislation, Engineering Education, Engineering Qualifications and Classifications, Remuneration, Closer Co-operation, by the members.

Afternoon Session—
- An Excursion.

### BETTER TIMES IN THE STEEL INDUSTRY PREDICTED.

After stating that the steel industry was in the worst slump that it had been in forty years, Charles M. Schwab, president of the Bethlehem Steel Corporation, in a recent speech at South Bend, Indiana, expressed himself as optimistic for the future. "The present industrial depression,' he said, "is the best thing that has ever happened to the United States. It has ended a long period of manufacturing without considering costs. We must build a new industrial fabric and that fabric must be built upon a basis of economy. Germany is organized industrially and never before have German workmen been so willing as they are now to give a full day's work for a full day's pay. Capital and Labor must work hand in hand as it has never done before, and this will result in a greater prosperity than we have ever had before," said Mr. Schwab.

### PORTABLE HOUSES BEING IMPORTED INTO HOLLAND.

A local building concern in Rotterdam recently inaugurated a new class of houses for permanent occupancy, by importing half a dozen portable wooden houses from Austria, says Kelly's Monthly Trade Review. These houses have been "placed" at a dry dock company's site, to be utilized by the company's employees; and it is understood that such satisfaction was felt with the first six houses that an order was immediately placed for another twenty-five houses. On the spot, ready for occupation, these houses cost the company about 3,200 florins; are very substantially built, splendidly ventilated, with one sitting room, of 16 square metres, and three sleeping rooms, and with a total inside area of 47.85 square metres. Such houses will probably be imported on a considerable scale, and erected in the new Dutch garden cities, planned in various parts of the country. This is really the first serious attempt at importing portable wooden houses into the Netherlands. Of course, just now the importation of such houses from Austria and also from Germany should prove very attractive, owing to the present rates of exchange.

### NEW OXYGEN PLANT AUGURS INDUSTRIAL IMPROVEMENT.

It is stated that the Dominion Oxygen Company, Limited, will break ground during the present month for a new quarter of a million-dollar oxygen plant at Montreal, which will double the company's present capacity. The building will be 100 ft. x 100 ft., and will be substantially a duplicate of the company's Toronto plant, which until now has supplied oxygen to Canadian industrial users through five district distributing stations. The Montreal plant will be the second of five producing plants projected at the time the company was organized last year.

### THE AUSTIN LINE.

An interesting little pamphlet has just been issued by the Austin Machinery Corporation, entitled "Snapshots of the Austin Line." The booklet contains a number of interesting illustrations, showing the excavating, loading, mixing equipment, etc., of this company in actual operation.

### MR. D. K. TROTTER APPOINTED SECRETARY OF SANITARY AND HEATING ENGINEERS

Mr. D. K. Trotter has been appointed secretary of the Canadian Society of Domestic Sanitary and Heating Engineers, in succession to Mr. G. F. Frankland, Toronto. Mr. Trotter is also secretary of the Builders' Exchange, Montreal.

# The Greatest Business Enterprise of All Ages

**By Lester A. Sunderland, President Portland Cement Association.**

No factor in human experience, save labor, affects the comfort, happiness and prosperity of a people to such a degree as transportation, and the greatest factor in the transportation of the future is contained in the modern development and improvement of the countless railless highways of commerce.

This undertaking involves the investment of the people's money in such large sums that it staggers the most vivid imagination. The investments of the rail roads, in their palmiest days of expansion, shrink to paltry sums in comparison with the appropriations already made for highway improvement by many of our government bodies.

Not only has real activity in this great enterprise hardly begun, but it may be truly said the people generally have little conception of either its magnitude or import, and are not sufficiently informed of its potentialities to give it such intelligent consideration as would be imperative to the success of any large undertaking; and if the disastrous consequences of incompetence and mismanagement are to be prevented, the people must be awakened to the danger.

Can one conceive of the vast sum of five billion ($5,000,000,000) dollars being spent for public highways alone? Yet approximately that sum is to be spent in America during the next ten years in railless-highway development; more than one-fifth of that amount has already been appropriated.

Now, the question is, How is this fabulous sum to be spent? By whom, and for what? Obviously, the greatest business enterprise in the world's history cannot be successfully carried on by novices or the driftwood of society's economic failures. It requires the best character, engineering skill and ability extant to solve the problems involved, and only such should be employed.

In the world's market for brains, trained ability, and experience, the bids should be for the best that money will attract, to carry on this colossal work; otherwise true progress will be impeded while the people's money is being worse than wasted. Highway improvement activities should be divorced from politics; the best men available should be selected, and retained permanently or as long as they render god service; and they should be given authority to build the types of highway best suited to the traffic needs, and held accountable for so doing. What business undertaking could succeed if the management were periodically changed? How important it is that the development of the great modern highways shall not be characterized by the waste and corruption often incident to political changes and interference! The great Lincoln's advice, "It is no time to swap horses when you are crossing the stream," is as pertinent here as in the circumstances under which it was given.

There are many types of hard-surfaced highways, but the test of long experience under the most severe traffic conditions should decide the choice. That type which, under modern truck and automobile traffic, over a stretch of fifteen or twenty years, will afford—whether wet or dry, hot or cold—an even, hard, safe. dependable, all-the-year-round road for the lowest ultimate total cost (namely, first cost plus maintenance) is the type that will always be chosen by the best-informed and most conscientious engineers, where funds are available to build them, since the best, whatever the first cost, is cheapest in the end.

The permanence and utility of a road should be built into it at the outset, both of which can be attained by the adoption of suitable type and design, and honest construction under proper supervision.

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## THE "REFLEX" PENDULUM CONTROL.

A mechanism has been inroduced for controlling the pendulums of workman's registers. Although many modern firms have adopted an impulse or time circuit in their factories, some have delayed fitting their workman's registers with electric control, owing to the fact that an interruption of the time circuit disturbed the workman's registers as well as the clocks. When unification of workman's registers was first attempted, the electric clock maker proceeded to do so by substituting for the spring-driven clock work, an electrical step-by-step or impulse movement. Such a substitution avoids the necessity of winding, but introduces other troubles, because the comparatively low power of the impulse movement leaves little margin for stiff places in the clock mechanism, which stiff places occur from time to time as the register is used, and the gears of the mechanism become clogged with dust. Or again, during any structural alterations to the premises the time circuit is liable to disturbance, and even stoppage, unless great care is used, and consequently the checking and costing system is disorganized.

The next step to overcome some of these possibilities was to "scape" the existing mechanism electrically. By this method the pendulum was removed, and an electrical scaping mechanism substituted, which, operating every half minute by means of the time circuit, allows the clock train to run on in half-minute intervals. This principle is sound and practical. but still it does not remove the possibility of a stoppage if the time circuit is interrupted, for the reason just mentioned, and, moreover, the removal of the pendulum permits the maker to plead interference if the type mechanism needs attention.

The final development in workmans registers is seen in the "Reflex" pendulum control, made by Messrs. Gent & Co., Ltd., Faraday Works, Leicester. By this arrangement nothing is removed from the register, but an addition is made thereto in the form of the "Reflex" control mechanism. This consists of two main parts; one, the "Vibrator," is clipped to the pendulum rod, no drilling or tooling being necessary; the other part or "Stator" is screwed to the woodwork of the register by wood screws or by nuts and bolts, as may be desirable. The register is "wound up" in the usual way. It operates by the clockwork exactly as supplied by the maker, but by the "Reflex" movement the pendulum is compelled to keep time with the transmitter controlling the time circuit of the factory, and the other clocks in the circuit. The pendulum should be so rated that the clock does not "gain." It must be given a slightly losing rate, but need not be set to lose more than two minutes per day of twenty-four hours. So effective is this control that in a pendulum beating 88 per minute, as is the case with some of the best known makes of recorders, it will effectively deal with a loss as much as ten minutes per day.

# Successful Production of Machine-Made Lime Mortar

## An Outline of the Hay Process for the Manufacture of Lime Products at a Central Plant by Mechanical Methods—Cheaper and Superior Mortar is Claimed

By W. C. Hay before the annual convention of the National Lime Association

Concerning machine-made mortar, Mr. Kidder, in his authoritative and nationally known "Architects and Builders' Hand Book," says:

"In several of the larger cities plants have been equipped for the manufacture of mortar by machinery Machine-mixed mortar should be much beter than the ordinary hand-mixed mortar for the reason that time can be given for the lime to slake, the lime and sand can be accurately measured and the hair and sand are not mixed with the lime until just before delivery. The mixing may also be more thoroughly and evenly done by machinery than is possible by hand."

The foregoing claims of superiority of the machine-made over the hand-made mortar were demonstrated over twenty years ago, and yet in the face of such truths, those wet mortar plants referred to by Mr. Kidder, as well as those which were later erected, proved almost without exception, to be unprofitable investments. With the exception of two, all those former plants have been dismantled and sold as junk. The two referred to have continued to operate with only varying degrees of success.

In view of such a showing, is it any wonder that a deep-seated prejudice grew up in the minds of many lime manufacturers, masons' supply dealers and others? Such prejudice, however, that went so far as to condemn the entire mortar plant idea was as unjust as it was unreasonable.

This paper has been prepared partly with the object of correcting such misunderstanding of this basic business, and accordingly we propose to present the salient facts connected with the evolution of the mortar business; its start, its failures, its growth, and its final success, together with a frank and impartial analysis of the causes underlying the downfall of the early plants.

As far back as 1866 a patent was issued for a mortar plant design. The design was so impractical, however, as not to merit further mention. Since that time patents of many descriptions have been granted which directly or indirectly referred to mortar plants, mixers, slakers, compositions, etc. Notwithstanding the fact that most of these invenions were impractical, they did prove that a lot of people considered the making of mortar by "the man with the hoe" method wrong.

### Faults of Early Plants.

The most active period of invention and construction of central mixing plants was between the years 1890 and 1905. In that time plants were erected in many large cities. While every plant claimed its own separate patent, the fact remains that with very few exceptions all of those plants were designed and constructed along the same lines. The results conclusively proved that the designs were fundamentally wrong. To those broadly experienced in the operation of mortar plants, the following list of errors in those designs are readily apparent:

1. General arrangement of plant too cumbersome, its size and cost being out of all proportion to its ability to turn out finished products.
2. Too much weight supported above ground.
3. Excessive machinery installation of improper type, resulting in high consumption of power.
4. No proper means provided for properly storing or feeding the lime to the slakers, resulting in extra labor expense.
5. No proper means provided for properly storing or feeding the sand to the mixers, resulting in extra labor expense.
6. No proper means provided for handling aged or cured lime putty, resulting in extra labor expense
7. Poor slaking methods.
8. Poor mixing methods.
9. Poor delivery methods.
10. Most important economic feature entirely overlooked, viz.: aerating of cured lime putty.

In pointing out these erroneous features, it has often been remarked: "Why, if these were such serious mistakes, were they not sooner discovered and rectified?" In considering this inquiry, these facts must not be lost sight of: that all those plants referred to were erected within a very few years of each other; that every plant had a separate inventor and ownership; that every owner and inventor had no extended mortar business experience; that there was no co-operation between the several inventors or owners to discuss, study and improve the inventions. That such a condition existed is not surprising, as the business was purely local in its nature, being limited to such market that existed within only a few miles of the plant.

### Improvement Not Worked Out.

In the face of this limited view, and as the continued operation of the plants showed no profit, the owners concluded that the business was not worthy of serious consideration, and therefore closed their eyes to the working out of essential improvements. The closing chapter of every plant was the same, and, accordingly, no advancement was recorded in the art of manufacturing and delivering ready-mixed mortar for many years.

How different was the story of the automobile: The first auto and the first mortar plant were built in the same decade. Both were failures, but perseverance by those pioneer auto mechanics in the face of failure and discouragement resulted in the most stupendous success. Contrast this with the mortar plant builders, who laid down on their first failure and said it could not be done; that the idea was unsound and impractical

These premature conclusions stood unquestioned for many years, and not until the year 1913 was their falsity proved. As a fitting introduction to the inventive work that was done after the failure of those early plants, and prior to 1913, permit me to recite some intimate gossip that will serve as a context to the rest of our story.

In 1908, while visiting an old schoolmate in Mexico City, I met a prominent engineer. The acquaintance subsequently ripened into a warm friendship, and in our talks we often discussed the many construction innovations that had been introduced in America. Among them was the mortar proposition. The idea of mixing mortar at a central station and delivering it to the building ready to use, struck me as a good one. Upon returning home I at once set out to collect all of the data I could on the subject.

### First Attempts Proved Fruitless.

My first point of attack centred on the lime manufacturers' and masons' supply dealers. Their advice and information concerning the mixed mortar scheme was so gloomy and discouraging that I soon passed them up. My attention was next centred on three plants which at that time had not been dismantled. This investigation was carefully made and painstaking in the extreme, and when completed it was obvious that the mortar idea was all right, but that the plants were all wrong. With the meagre knowledge gained, I studiously set to work to make a plant that it was believed would be altogether right. The design was radical and the plant, when completed, would not work. Several arduous and discouraging weeks were spent in tearing down, changing, rebuilding, etc. Finally the affair developed to a point where it could turn out a fair grade of brick mortar at a slight saving. Needless to say, this plant fell far short of my ideal. Accordingly, I again set to work on a new design which it was believed would be correct in every detail. This plant never did produce a yard of mortar. The seemingly improved machines simply would not function. After weeks spent in tearing out and rebuilding, I dismantled the plant and erected on the same site another one, which was also a mechanical failure.

These experiences extended from 1908 to 1911, and notwithstanding the time and energy lost, together with the thousands of dollars thrown into the discard, my belief in the soundness and practicability of the mortar idea never wavered. In fact, these failures only seemed to make me more determined to work out some right plan. At this point the painful conclusion was reached that I knew very little about mortar plants, or anything connected with the business. After pulling up the slack in my belt, I grimly set out to learn something about the subject, and accordingly, every book which could be found that dealt with limes, mortars, plasters, mixers, mortar plants, hair pickers, agitators, sand, etc., was read. Also copies of all patents were secured that in any way related to plants, mixers, plastic compositions, processes, etc.

### A Successful Plant.

After two years of study I again made another attempt and in 1913 designed and erected a plant in Oakland. This was a success from the day it started. Its cost was low, operation simple, and the results profitable. Patents which I then had pending were later granted, and owing to the success of this plant, the San Francisco rights were soon purchased by those who were the chief stockholders in the Oakland plant.

I designed and erected the San Francisco plant in 1914, in which was incorporated some added improvements. That plant was also a success from the day it opened. Both plants were then taken over and operated by the Atlas Mortar Company. It can be said that this company has for years dominated the lime and mortar business of the two California Bay cities. They enjoy a very large business in ready-mixed brick mortar, fibered lime plaster, Keenes cement gauged lime plaster, and lime putty.

In 1915 Mr. J. W. Jameson, a large and successful oil operator of California, after seeing the San Francisco plant, purchased my Los Angeles rights, and entered into a contract with me to build a plant. His purpose in doing so was to market lime from the Jameson Lime Companys kilns, which plant had been closed down for several years, owing to the falling off in the plastering lime business occasioned by the growth of the gypsum plasters. This Los Angeles mortar plant commenced business in the spring of 1916 under the name of the Blue Diamond Plaster Company. At that time prices of lime, sand, plaster and labor were at the bottom. Also, the builders were using only gypsum plaster. In the face of these apparent unfavorable conditions under which to start a mortar company, the concern did a good business from the start. Brick mortar was at once marketed in large volume, a cubic yard being manufactured and hauled a distance of up to three miles at a price of $2.10 per cubic yard, 15c being added to each cubic yard for every additional mile delivered.

Just consider for a moment what economies were necessary in order to be able to make such a price Needless to say, the company did not get rich. Nevertheless, it must be added that it did not go into red ink either, which is saying a whole lot when those unfavorable conditions are considered. A drive was also made on Keene's cement, gauged lime plaster for interior work, and lime plaster gauged at the building with Portland cement for exterior work, also finishing putty.

### Success of Mortar Plants.

The news of the success of the three California plants spread rapidly and it was not long before letters of inquiry were received from many sections of the continent. As Los Angeles was my home, and as the future for the business looked promising, I purchased an interest in the company from Mr. Jameson. We then incorporated with a paid-up capital of $100,000.00. Our resources then included a two-unit Hay mortar plant, capable of turning out approximately 150 cubic yards of mortar per day, and 100 barrels of finishing putty; a small sand and gravel plant, and a few auto trucks.

While this lasted our tonnage was very small, owing to the limited building activity. Throughout this period, however, we were able to operate without a loss. Soon after the signing of the armistice building became brisk, and the plant tonnage jumped ahead at a surprising rate. Our sand and gravel facilities were then increased, and we also added a few staple lines of building materials. Warehouses were then built; the Jameson Lime Company was taken over; fifteen extra acres in the manufacturing district of Los Angeles were acquired; a hydrating unit was erected; the largest stone crushing plant and quarry in Southern California was purchased; the exclusive marketing of a gypsum mill was secured; distributing rock bunkers were erected in the city; many additional auto trucks were added and our stock of general builders' supplies was greatly enlarged. Two other manufacturing units are just now being added.

To-day this company does the largest masons' supply business in the West, and the company has resources of one and one-half million dollars. Our activities include manufacturing, wholesaling and retailing, Los Angeles city being the retail centre, while wholesaling is done in the outside territory.

Our daily tonnage is approximately 70 carloads in the entire territory. Our retail business in Los Angeles city requires upwards of forty auto trucks for the delivery of the different products.

### Prices of Mortar Plant Products.

At the present time our retail prices on the mortar plant products are:

Brick laying mortar, $4.25 ped cu. yd.

Fibered lime plaster mortar, $6.00 per cu. yd.

Keene's cement gauged lime plaster mortar, $9.50 per cu. yd.

Lime putty, 70c per cu. ft.

These prices are f.o.b. plant, and cartage is charged extra. All mortar is sold by the cubic yard and is delivered in regular stock type auto dump trucks. A minimum charge of $1.00 per cubic yard is made for delivery, which charge covers a distance of approximately three miles from the plant. Additional mileage is charged at the rate of 15c per cubic yard per mile.

The lime putty is delivered in second-hand iron barrels which are easily handled at the job. Barrels are charged out at $1.00 each and credited back when returned in reusable condition, at 90c each.

The above schedule of prices shows that a cubic yard of brick mortar is delivered in the business section of Los Angeles for $5.25, or $5.00 if the bill is paid on or before the 10th of the following month.

Now for the sake of comparison, recall to your minds what this cubic yard of ready-to-use mortar would cost if made up by the contractor at the building. One cubic yard of sand would be required, approximately 300 pounds of first-class quick lime, and approximately one-fifth of a labor day of two hod carriers to slake, mix and temper. With sand at $1.75 per cubic yard at the job, lime at $20.00 per ton, and a hod carrier at $6.00 per day, the cost of a cubic yard of mortar, when made up at the building, would amount to approximately $6.00, and mark you, this is an extremely low cost. In most cities to-day this cost is nearer $7.00 than $6.00. The comparative cost of plaster mortar is even more marked than of brick mortar and when compared with gypsum plaster mortar, is extremely marked. A cubic yard of gypsum hardwall mortar contains approximately half ton of plaster, one cubic yard of sand and one-third of a labor day. Plaster at $20.00 per ton net, delivered at the job, sand at $1.75 per cubic yard and the hod carrier at $6.00, would make a total cost of $13.75 per cubic yard. Our selling price, as above stated, on fibered lime plaster delivered at the job in the business district, is $7.00 per cubic yard. These selling prices are quoted and the comparison is made in order to clearly bring out the fact that, although our mortar department is the most profitable one of all departments, our selling prices are really very low.

### Why Is the Cost So Low?

The next question that arises is "How can the plant make such good profits at the prices obtained for the products?" Generally speaking, for two reasons: First, that the plant can use any grade of kiln run lime, second, that the process of manufacture is such as to effect a large economic saving.

The first reason needs no explanation. The extra cost of producing selected lime for the lump trade, which high standard of quality must be maintained to hold your prestige and business, is well known. By having the mortar plant, our lime cost is less It is not essential or necessary to pick only the clear rock which will make good looking lumps of lime. Also, the fuel cost is lower, as the stone does not have to remain in the kiln until the last atom of carbon dioxide is driven off, and in addition, the troublesome and expensive barrel or package feature is altogether eliminated. Where the contractor will not have corey lime, the mortar plant is not so particular. In the plant the core ash. or any impurity, is automatically thrown out as the slaked flued flows from the slaking machine to the curing vats.

### Features of Operation.

The second reason advanced for the plant being able to make such good profits is best set forth by describing the method of operation. The fundamental features embodies in our plant, and which are essential for the successful operation of any mortar plant, are the following:

1. Low plant cost.
2. Minimum machinery installation of simple type and rugged construction.
3. Design of such nature as to permit elastic operation that would allow small or large output without changing normal labor requirements.
4. Utilization of aerating principle.

These underlying principles of construction and operation have been closely adhered to in the Hay process, and I herewith enlarge on each principle involved:

1. A single unit plant capable of a maintained daily output of upwards of 100 tons of finished mortars per day can be built at a cost of from $8,000.00 to $10,000.00. A two-unit plant with upwards of 200 tons daily capacity can be erected at a cost of from $15,000.00 to $18,000.00.

2. The larger of these two plants contains only five separate machines. The designs are such that the machines are driven with a minimum of power, while the wear and tear is negligible. The total power installation in the entire plant is less than 50 h.p. All machines are driven by separate and direct connected electric motors.

3. The plant is operated to its capacity with two men, and if a tonnage of half the capacity of the plant is maintained, one operator is sufficient. The slaking, curing and mixing features are so arranged as to make it possible for the one operator to be kept busy continuously. The mixers are of a continuous type and are of such speed as to permit of the turning out of a finished cubic yard of mortar in two minutes.

4. The aeration of the cured lime putty is, without doubt, the greatest advance made in the art of producing ready-mixed mortar. By violently agitating the cured lime putty, it is given by a spreading ability of upwards of 25 per cent. of its former stretch. At the same time this agitating does away with the very excessive labor handling charge that was formerly required. Also, this agitation reduces the stiff putty to a thick fluid consistency, making it possible to feed

the cured lime paste in a steady, measured flow to the mixers.

When it is considered that this two-unit system with a large and elastic capacity can be erected at a cost of approximately $16,000.00, and can be operated to its capacity with two men with less than 50 h.p. and can produce the highest grade of mortars and putty with a saving in lime content of approximately one-third (kiln run, at that) than mortars prepared in other ways, you cannot wonder that these plants have made such a record of success in the cities in which theyhave been erected.

### Quality of Machine-made Products.

As to the quality of the products turned out by these plants, too much cannot be said. The products are properly slaked, properly cured, thoroughly mixed and work cool and smooth under the trowel. As one hydrate manufacturer aptly says: "They spread like warm butter." Hard and soft lime mortar, both fibered and unfibered, are made with equal ease, and are extensively used and sold for exterior and interior plastering, and are ideally adapted to all kinds of construction, being suitable for application over good lath, metal lath, and patent laths, on tile, brick or concrete surfaces.

The advantages and disadvantages resulting from the use of lime mortars are familiar to you all. The advantages are many and varied and the disadvantages are practically all eliminated when lime mortar of high quality and low price can be delivered to the building in a ready-to-use condition.

The future for these plants is very bright. The success of the process has been clearly demonstrated in the face of the most difficult conditions. The mortar market is almost as staple as the bread market. The demand is tremendous and no one is in the field but "the man with the hoe." The builders are not only willing, but anxious to give up the making of mortar at the job, and they stand literally hungry to buy these high-grade mortars at a price equal to their (prepared at the job) cost, and, mind you, their cost allows the plant a very substantial profit. In fact, a much larger profit than is earned by the lime manufacturers.

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# Brick Making Cost Criticized

## Manufacturer Dissatisfied with the Analysis Which Appeared in the Contract Record of July 6 — Discussion is Welcomed

An article appeared in our issue of July 6 signed D. S. Gray, and entitled "An Analysis of the Costs of Manufacturing Brick." This is a most interesting subject for the brick manufacturers. It is scarcely likely, however, that manufacturing costs in all districts are the same, and it is not strange that a manufacturer in another locality should take exception to the figures in this article, which, as we understand it, are only intended to be considered relatively. They certainly could not represent a standard cost on account of the variable factors that necessarily introduce themselves.

We are glad to have remarks regarding this article and are pleased to print below a letter from Mr. McFarren of the Interprovincial Brick Co. Mr. McFarren thinks that we should not have published this article without first ascertaining whether the figures were approximately correct. What we did do was, we think, something better. We satisfied ourselves that the article was written by a man who had had a long connection with the brick business and who at the same time was well trained and equipped to write an analytical article of this nature.

We are glad to give the same publicity to discussions on this article as we have given to the article itself. Generally speaking, much good results from open discussion. So far as it can be made a matter of education for the brick industry we should like to see the discussion continued.

Editor,—

Having read an article in your issue of July 6th supposed to be an analysis of the cost of manufacturing brick, I am writing to say that I think it very unfair to the brick manufacturers to put such an article in your paper without first ascertaining whether or not the figures you use are even approximately correct.

If Mr. Gray could put into practice at the present time what he publishes in his article we would be very glad to pay undoubtedly the largest salary ever paid any man operating a brick plant.

In the first place, the cost of obtaining the shale alone is so much lower than we can obtain shale with steam shovel operation that we would like to find out how he gets it out so cheaply. Then laborers must be working for a ridiculously low wage to allow for the manufacture of brick at $1.09 per thousand. Power and fuel at $1.25 is also pretty low. Maintenance of machinery 27 cts. per thousand seems to us to be about 20 per cent. to 25 per cent. of what it should be in order to keep machinery working. Wheeling and setting is also lower than we seem to be able to make it; and as for burning, it is simply wonderful. In fact, brick making on this basis would be so profitable that all the brick makers would have long since retired to enjoy their wealth, if such costs were possible.

The only item that we can compare with in our business is the overhead expenses, but perhaps Mr. Gray is operating a plant in conjunction with a coal mine, where coal is supplied almost free of charge.

We find the cost of the wages of the burners firing the filns to be about one-half of Mr. Grays cost of the labor and fuel for burning.

It would seem only fair that you should check up these costs before giving the much abused brickmaker further cause to be charged with profiteering. As you know, most brick makers have failed to even make a living for a number of years on account of selling their material below what it cost them to manufacture.

Yours very truly,

F. B. McFARREN,

General Manager Interprovincial Brick Co. of Canada, Ltd.

Toronto, July 7, 1921.

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### IMPORT AND EXPORT OF CEMENT IN SPAIN.

The Gaceta de Madrid for May 8 contains a royal order dated May 3 which re-establishes the customs duty (50 centavos per 100 kilogs.) on cement, which was temporarily suspended by the royal order of October 26 last. Consignments proved to have been despatched direct to a Spanish port up to May 9, inclusive, will be admitted duty free. The order further authorizes the free exportation of 100,000 metric tons of natural and artificial cement.

# Standard Specifications for Wood Block Paving

## Recommendations Based on the Suggestions of the Principal Advocates of Wood Blocks, Coal Tar and Asphalt After Thorough Study of the Requirements

**By S. M. Feinberg, C. E., Public Works Office, Building No 13, U.S. Navy Yard, Brooklyn, N.Y.**

After a thorough study, using all available government information at my disposal, I drew up specifications covering the problem and sent a rough draft for comment and criticism to the principal promoters of wood blocks and coal-tar and asphalt.

The following specifications are a revised and corrected edition of the original rough draft, based on the constructive criticism of a number of competent men, and are up-to-date, both in regard to materials used and methods of construction.

Inasmuch as the present season will see an appreciable amount of pavement construction, I hope the specifications as presented may prove timely and sufficiently adequate. They are reprinted herewith by courtesy of Municipal and County Engineering.

Especial credit is to be given to the following parties who were kind enough to assist the writer in compiling the specifications.

(1) Philip P. Sharples, Manager, General Tarvia Dept., The Barrett Co.

(2) R. R. Barrett, Engineer, The Texas Co.

(3) J. E. Morris, Manager, Street & Road Dept., and C. N. Forrest, Manager, Technical Dept., The Barber Asphalt Paving Co.

(4) Prevost Hubbard, Chemical Engineer, The Asphalt Association,

(5) F. P. Allen, Manager Road Oil and Asphalt Department, The Standard Oil Co. (Ind.).

(6) H. S. Rinker, C. E., Expert Aide, U.S. Navy Yard, Brooklyn, N.Y.

(7) Lambert T. Ericson, Chief Engineer, the Jennison-Wright Co.

Likewise credit is due to Messrs. Herman von Schrenk, Consulting Timber Engineer, and W. W. Horner, Chief Engineer of Sewers and Paving, St. Louis, Mo.

### General.

1. **Scope of Work.** Work required includes the provision of all implements, machinery, equipment, tools, material, and labour necessary for the proper installation of all wood block paving, in accordance with the drawings, this specification and intent thereof, and when completed, the work shall be left in a neat and finished condition.

2. **Materials and Workmanship.** All material and workmanship shall be of the best quality of their respective kinds, unless other grades are specifically mentioned, and the acceptance of same is understood and agreed to be subject to the approval of the engineer in charge.

3. **Samples Required of Contractor Before Work is Begun.** The contractor shall submit to the engineer in charge, for approval, samples of wood block, Portland cement, sand, bituminous materials, and such other samples of materials as may be required, whether specifically called for or not. Accepted samples may be used in the finished work. Materials shall conform to samples. The approval or acceptance of such samples shall not preclude the rejection of any material upon the discovery of defects previous to the acceptance of the finished work.

4. **Loading and Unloading.** All blocks shall be loaded and unloaded with care. They shall not be thrown from cars into wagons, dumped from wagons, nor shall they be piled in any location where they would likely become bespattered, covered with mud, or otherwise injured.

5. **Warranty.** The contractor shall warrant the entire work to be free from defects of workmanship or materials for a period of one year from date of acceptance. He shall furnish a written warranty, satisfactory to the engineer in charge, and he will make good at his own cost and expense any defects developing during that period.

### Timber.

6. **Kind.** The wood from which the blocks are to be manufactured shall be thoroughly air seasoned, dry, Southern yellow pine.

7. **Quality.** The blocks shall be sound, well manufactured, square butted, square edged, free from unsound, loose or hollow knots, knot holes and other defects such as shakes, checks, etc., that would be detrimental to the life of the blocks, or interfere with the proper laying of the same.

The number of annual rings in the inch which begins 2 ins. from the pith of the block shall not be less than six measured radially, provided, however, that blocks containing between five and six rings in this inch shall be accepted if they contain 33⅓% or more summer wood. In case the block does not contain the pith, the inch to be used shall begin 1 in. away from the ring which is nearest to the heart of the block. The blocks in each charge shall contain an average of at least 50% of heartwood. No one block shall be accepted that contains less than 25% of heartwood.

8. **Size of Blocks.** The blocks shall be from 5 to 10 ins. long, 3 and 3½ ins. in depth, for bituminous and non-bituminous cushions respectfully, with the grain or fibre of the wood running in the direction of the depth. They shall be from 3 to 4 ins. in width, but in any one city block they shall be of uniform width. A variation of 1/16 in. in depth, and ¼ in. in width from the dimensions specified will be allowed.

9. **Lug Blocks.** In case lug wood blocks are used, they shall have two "V"-shaped lugs on the side of the block and one "V"-shaped lug on the end of the

block. The lugs shall extend the full depth of the block and shall be an integral part of the block. The lugs shall extend away from the block either ⅛ in. or 3/16 in. at the opinion of the engineer in charge, and shall be approximately ¼ in. in width at the base where they join onto the block. The lugs on the side of the block shall be spaced approximately 5 ins. apart, center to center of lugs, or approximately 2½ ins. from center of the block measured lengthwise. The lug on the end of the block shall be placed in the center of the block. The grain of fibre of the lug shall run in the same direction as the grain or fibre of the block.

### Preservative.

**10. Kind.** The preservative to be used may be either a coal-tar paving oil " A," or a coal-tar distillate oil " B " as specified herein below.

All tests for the preservative used shall be made in strict accordance with the Standard Methods of the American Wood Preservative Association.

**11. " A " Coal-Tar Creosote Paving Oil.** This oil shall be a coal-tar product of which at least 65% shall be distillate of coal gas tar or coke oven tar, and the remainder shall be refined or filtered coal gas tar or coke oven tar. It shall comply with the following requirements:.

It shall not contain more than 3% of water.

It shall not contain more than 3% of matter insoluble in benzol.

The specific gravity of the oil at 38 deg. C., compared with water at 15.5 deg. C., shall not be less than 1.07 nor more than 1.14.

The distillates based on water free oil shall be within the following limits:

Up to 210 deg.C., not more than 5%.

Up to 235 deg. C., not more than 25%.

The residue above 355 deg. C., if it exceeds 35% shall have a float test of not more than 80 sec. at 70 deg. C.

The specific gravty of the fraction between 235 deg. and 315 C. shall not be less than 1.03 at 38 deg. C., compared with water at 15.5 deg. C.

The specific gravity of the fraction between 315 deg. and 355 deg. C., shall not be less than 1.10 at 38 deg. C., compared with water at 15.5 deg. C.

The oil shall not yield more than 10% of coke residue.

**12. " B " Coal-Tar Creosote Paving Oil.** This oil shall be a distillate of coal gas tar or coke oven tar and shall comply with the following requirements:

It shall not contain more than 3% of water.

It shall not contain more than 0.5% of matter insoluble in benzol.

The specific gravity of the oil at 38 deg. C., compared with water at 15.5 deg. C., shal not be less than 1.06 .

The distillate's based on water free oil shall be within the following limits:

Up to 210 deg. C., not more than 5%.

Up to 235 deg. C., not more than 15%

The residue above 355 deg. C., if it exceeds 10% shall have a float test of not more than 50 sec. at 70 deg. C.

The specific gravity of fraction between 235 deg. C. and 315 deg. C. shall not be less than 1.03 at 38 deg. C., compared with water at 15.5 deg. C.

The specific gravity of the fraction between 315 deg. C. and 355 deg. C. shall not be less than 1.10 at 38 deg. C., compared with water at 15.5 deg. C.

The oil shall not yield more than 2% of coke residue.

### Creosoting.

**13. Method " A."** (Full Cell Process.) The wood blocks after being cut and ready for treatment, shall be placed in a suitable iron receptable or cylinder and there sterilized with dry steam under a pressure of not less than 30 lbs., and not more than 50 lbs. per square inch for not less than three hours and as much longer not to exceed seven hours, as the condition of the wood may require. The temperature within the cylinder during the process of steaming shall be between 250 and 280 deg. F. At intervals during this process the condensed steam, sap, and other liquid matter shall be drawn from the receptable by means of valves. At the completion of the steaming process all condensed steam and other fluid matters shall be blown from the cylinder through an opening in its bottom and all the steam shall be caused to pass out through an opening in its top.

The drain and exhaust valves of the cylinder shall then be closed and a vacuum pump shall produce a vacuum of at least 24 ins., and as much more as may be necessary as quickly as possible. The vacuum shall be maintained in the cylinder until the moisture and gases cease to escape therefrom. During this process the wood blocks within the cylinder shall be kept hot by means of steam coils.

Immediately thereafter, and while the vacuum still exists, creosote oil, having a temperature between 180 and 200 deg. F. shall be run into the cylinder and such pressure maintained that the wood blocks shall be impregnated with creosote oil to the amount of not less than 12 lbs. of creosote oil per cubic foot of timber. The excess of creosote oil in the cylinder shall then be withdrawn and the blocks drained and prepared for shipment.

**14. Method "B"** (Empty Cell Process.) The blocks shall be placed in an air tight cylinder and subjected to an initial air pressure of not less than 440lbs. nor more than 80 lbs per square inch, depending upon the seasoned condition of the timber to be treated. until all the cells and cavities of the wood are filled with air.

While the initial air pressure is maintained, the creosote oil at a temperature of not less than 150 deg. F. shall be introduced into the cylinder at a still higher pressure. As the creosote oil is being forced into the cylinder, air shall be allowed to escape into an auxiliary air chamber through a valve located at the highest point of the cylinder in order to completely fill the cylinder with the hot creosote oil without reducing the initial pressure.

As soon as the blocks are completely covered and the cylinder entirely filled with the hot creosote oil, the initial pressure shall be gradually increased by forcing in additional quantities of creosote oil, until a maximum quantity of oil has been injected, under a total pressure of about 150 lbs per square inch. The creosote oil shall be maintained at a temperature of not less than 150 deg. F. during the entire pressure period within the cylinder. In this way as much oil shall be forced into the timber as it is possible to inject under safe temperature and pressure.

The pressure shall then be cut off and the creosote oil discharged from the cylinder.

Hydraulic presure of not less than 100 lbs. per square inch shall then be applied and maintained until a total quantity of not less than 12 lbs. of creosote oil per cubic foot of timber as been forced into the blocks. The temperature of the oil within the cylinder during this period shall be maintained at not less than 150 deg. F.

The pressure shall then be cut off and the creosote oil discharged from the cylinder.

### Cushion Materials.

**15. Coal-Tar Pitch.** The pitch used for pitch paint coat, as described hereinafter, shall be straight run residue obtained from the distillation of coal tar, and shall comply with the following requirements:

The melting point, determined by the American Society for Testing Materials Tentative Method, shall not be lower than 140 deg. F., nor higher than 150 deg. F.

It shall contain free carbon not less than 18% nor more than 37 per cent, insoluble in hot chloroform and benzol.

The specific gravity at 77 deg. F., shall not be less than 1.22 nor more than 1.34

The specific gravity of the distillate up to 355 deg. C., shall not be less than 1.07 at 38 deg. C., compared with water at 15.5 deg. C.

When 100 g. are distilled at 670 deg. F., by the A. S. T. M. method, using a 250 c.c.Engler Flask, the specific gravity of the distillate shall not be less than 1.07 at 100 deg. F.

The pitch shall be heated to a temperature not exceeding 325 deg. F., and shall be poured at a temperature between 250 deg. and 300 deg. F.

**16. Asphaltic Cement.** The asphaltic cement, used for asphalt and mastic cushion, as described hereinafter, shall comply with the following requirements:

It shall be thoroughly homogenous free from water and shall not foam when heated to 350 deg. F.

It shall have a penetration at 77 deg. F. of from 50 to 60

It shall not flash below 350 deg. F.

When 50 grams of the asphalt cement are heated for five hours at 325 deg. F., in a tin box 2¼ ins. in diameter and 1½ ins. deep the loss shall not exceed 3% by weight of the penetration at 77 deg. F., and the residue left after such heating must not be less than the penetration at 77 deg. F. of the orignal sample before heating.

When the asphalt cement is made into a briquette (Dow Mound) it shall have a ductility of not less than 30 cms. at 77 deg. F.; the two ends of the briquette to be pulled apart at the uniform rate of 5 cms. per minute.

**17. Tar.** Tar for tar sand cushion, as described hereinafter, shall conform to the following requirements:

The specific gravity shall not be less than 1.14 nor more than 1.18 at 60 deg. F. (15.5 deg. C.).

The vicosity tested by the standard Engler Viscosimeter shall not be more than 250 sec. nor less than 100 sec. for 100 c.c. at 104 deg. F. (40 deg. C.).

On distilling 100 c.c. of the material to 338 deg. F. (170 deg. C.), not more than 7% shall distill over. On continuing the distillation to 572 deg. F. (300 deg. C.) the residue shall not be less than 65 grams. This residue shall be soft pitch at 60 deg. F. (15.5 deg. C.). If the residue appears hard, it shall be tested for melting point and the melting point shall not exceed 140 deg. F. (60 deg. C.) by the ½-in cube method in water. The specific gravity of the entire distillate shall not be less than 1.01 at 60 deg. F. (15.5 deg. C.).

The free carbon shall not be less than 4% nor more than 12%.

In making the foregoing tests the following methods shall be employed:

(a) Specific gravity. The specific gravity shall shall be determined by the use of a Hubbard type specific gravity bottle. The bottle shall be filled with the liquid material at a convenient temperature. The bottle shall then be kept in a water bath at 60 deg. F. (15.5 deg. C.), until the level of the liquid, after adjustment to the mark, shows no further contraction. The bottle shall then be weighed. The weight of the material, divided by the weight of the same volume of freshly boiled distilled water at 60 deg. F. (15.5 deg. C.) is the specific gravity.

(b) Distillation. A 250 c.c. Engler flask shall be used and 100 c.c. of the material taken for distillation. The apparatus shall be set up and the distillation conducted as provided in the tentative method proposed by the American Society for Testing Materials.

The distillate shall be collected in weighted flasks and fractions shall be determined by weight.

Receivers shall be changed when the thermometer records a temperature of 338 deg. F. (170 deg. C.). When the thermometer records a temperature of 572 deg. F. (300 deg. C.) the flame shall be removed.

(c) Melting Point. A clean shaped ½-in. cube of the material shall be formed in a mould, placed on a hook of No 12 (B &S guage) copper wire and suspended in a 600 c.c. beaker so that the bottom of the cube shall be 1 in. above the bottom of the beaker, (a sheet of paper placed on the bottom of the beaker, and convenienty weighted, will prevent the pitch from sticking to the beaker when it drops off). The cube shall remain five minutes in 400 c.c. of freshly distilled water kept at a temperature of 40 deg. F. (4.5 deg. C.) before heat is applied. Heat shall be applied in such a manner that the temperature of the water shall be raised 9 deg. F. (5 deg. C.) each minute. The temperature recorded by the thermometer at the instant the material touches the bottom of the beaker shall be melting point.

(d) Free Carbon. The free carbon shall be determined by making a hot extraction of five to ten grams of material with C.P. Toluol followed by C.P. Benzol or C.P. Benzol followed by chloroform as solvents. The extraction shall be made in a Soxhlet, Knorr Underwriters, or some other suitable extraction apparatus. The distillation of the solvent shall be continued until the washings run through practically colorless.

(e) Vicosity. The standard shall be determined in a Standard Engler Vicosimeter at 104 deg. F. (40 deg. C.). Sufficient material shall be placed in the viscosimeter to bring the surface of the liquid to a level with the tops of the three leveling points. The time required to discharge 100 c.c. shall be recorded as viscosity.

**18. Cement Sand Cushion.** The cement sand cushion shall be composed of 1 part of Portland cement and four parts of sand, meeting the following requirements: (a) Portland Cement. All cement used in this work shall be Portland Cement, which shall conform to the latest standard specifications for Portland

Cement adopted by the American Society for Testing Materials.

(b) Sand. The sand shall consist of hard durable grains, absolutely free from stones or pebbles and free from vegetable and other deleterious substances. When dry it shall pass a ¼in. laboratory screen and shall be well graded from course to fine. The material removed by the elutriation test, consisting chiefly of clay and loam, shall not exceed 5% by weight.

### Filler Materials.

19. **Coal-Tar Pitch Filler.** The coal-tar pitch for filler shall be a coal-tar pitch as specified in paragraph No. 15.

20. **Asphalt Filler.** This filler, if used, shall be a bituminous material conforming to the following requirements:

It shall be homogenous, free from water, and shall not foam when heated to 200 deg. C. (392 deg. F.).

Specific gravity at 25 deg./25 deg. C. (77 deg./77 deg. F.) shall not be less than 0.980.

Flash point shall not be less than 200 deg. C. (392 deg. F.).

Melting point shall not be less than 78 deg. C. (172 deg. F.

Penetration at 25 deg. C. (77 deg. F.) 100 g., 5 sec. shall be from 30 to 50.

Penetration at 0 deg. C. (32 deg. F.) 200 g., 1 min., shall be from 10 to 20.

Penetration at 46.1 deg. C. (115 deg. F.) 50 g., 5 sec. shall be from 150 to 300.

When 50 grams are heated in an open tin to a temperature of 325 deg. F., for 5 hours, the loss shall not exceed one per cent, and the penetration at 77 deg. F. of the residue left after such heating shall not be less than two-thirds of the penetration of the original material before such heating,when tested at 77 deg. F.

Total bitumen (soluble in carbon disulphide) shall not be less than 95 per cent.

It shall show a ductility of not less than 30 centimeters when testel at 77 deg. F.

21. **Asphaltic Cement.** The asphaltic cement used for asphaltic sand mastic filler shall be the same as specified in paragraph 16.,

### Construction.

22. **Subgrade.** The bottom of excavation and the top of the fill shall be true to the lines, grades, and cross-sections given for the subgrade. After all drains have been laid and the subgrade has been shaped correctly, it shall be brought to a firm unyielding surface by rolling the entire area with a 10-ton roller. Any portion of the subgrade which is not accessible to a roller shall be compacted thoroughly with hand tamers, weighing not less than 50 lb., the face of which shall not exceed 100 sy. ins. All soft and yielding material, and other portions of the subgrade which will not compact readiy when rolled or tamped, shall be removed and all loose rock and boulders found in the excavation shall be removed or broken off to a depth of not less than 6 ins. below the surface of the subgrade. All holes or depression so made shall be filled with suitable material and the whole surface shall be compacted uniformly. If settlement occurs or in case an old stone or gravel roadbed is encountered, the depressions and all loose portion of the road bed shall be sacrificed, filled and rerolled until the surface is solid, uniform, and parallel with the required grade. In excavating, the ground shall not be plowed or disturbed below the surface of the subgrade, except as otherwise specified herein.

23. **Base Course.** All materials for the construction of base courses, including all necessary drainage during construction, clearing, grubbing and all excavation for sub-base work, as specified hereinabove, shall be performed in strict accordance with the cross-sections and in the best possible manner for this type of construction.

The concrete base course. 6 in. thick in its least depth, shall be composed of 1:2:5 and 1:3:6 mixture for bituminous and non-bituminous cushions respectively, and it shall be laid on a thoroughly compacted sub-base.

The crown of any base course shall not be less than ¼ in. nor more than ⅜ in. per foot of width.

If bituminous cushion is used, the surface shall be finished in one operation by means of a long-handled wooden floal provided with up-turned ends in order to prevent ridging; the surface when finished shall be such, that when tested with a metal-shod straight-edge 5 ft. long, laid upon it parallel to the curb, it shall show no departure from this straight-edge greater than ¼ in. Projections greater than ¼ in shall be trimmed down and all depressions shall be flushed even with a mortar consisting of 1 part of cement to 3 parts of sand.

If non-bituminous cushion is used, the base course shall be finished with a template arranged to give the proper grade and crown; the surface when finished shall be such that at no point it shall be above the theoretical finished surface. Depressions of small area not more than ½ in. below this theoretical grade and not general in occurrence, will be permitted and no attempt will be required to fill them to the general grade after the slab has set.

24. **Pitch Cushion.** (Pitch Paint Coat.) After the base course has hardened and is thoroughly dry, it shall be covered with a coat of pitch, as specified. **under the heading of "Cushion Materials," not more** than ⅛ in. in thickness. The pitch shall be applied at a temperature of not less than 250 nor greater than 300 deg. F., and it shall be allowed to cool and harden up before laying the blocks.

(To be continued in a subsequent issue)

## Advertising and Business

The "Commerce Monthly" for July, a journal of commerce and finance published by the National Bank of Commerce in New York, prints a valuable article entitled "Advertising and Business," written by the vice-president of the bank. The article points out the intimate association that has been shown to exist during the past ten years, during which figures are available, between the volume of advertising and the volume of bank clearing, and concluded as follows:

"The experience of the past ten years and especially that of the periods of depression in 1914-15 and 1920-21 seems to demonstrate that the place of advertising in the present economic system is thoroughly well established, and it seems improbable that there can be any very considerable permanent curtailment of its volume."

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## *Wage Reductions in Hamilton, Ont., Pave Way for Resumed Building Activity*

The finding of the Board of Arbitration recently appointed to investigate labour and building conditions in the city of Hamilton has brought in a recommendation to the effect that mechanics receiving 85 cents or more per hour should accept a reduction of 10 cents per hour, and less than 85 cents a reduction of 5 cents per hour. In making this recommendation the arbitrators stated that they had found a quantity of building in contemplation in the city which was being deferred on account of the high cost of construction. In the opinion of the majority of the Board, therefore it was very necessary under existing conditions that the opportunity of employment should be increased as much as possible during the remainder of this year's building season. The following scale is recommended: carpenters, 75 cents an hour; sheet metal workers, 80 cents; plasterers, 90 cents; steam and operating engineers, 75 cents; electrical workers, 75 cents; painters, 62 cents; common labour, 50 cents. It is understood that the men agreed to stand by the recommendation of the Arbitration Board, so that these figures may now be considered as representing the recognized scale in the building industry in the city of Hamilton.

It remains to be seen whether this award will have any influence on the Toronto situation. It is, evidently, based quite largely on the argument that a reduction in the cost of construction will stimulate buildactivities. This, plainly, is impossible. It is a logical conclusion, however.

In asking labour to accept a reduction of 10 cents an hour, which amounts to 10% or less in every case, it should be emphasized that they are not being asked to lower their standard of living. The cost of living has been reduced from 20 to 25%, depending on the items included in the calculations. As pointed out in our last issue, rents are the only thing that hold up, and they can only be brought into line by increasing the supply of houses in keeping with the demand. This in turn, can only be brought about by increased building activities, which in turn seem to be dependant in a considerable degree on reduced labour costs. In accepting reduced wages, labour will at the same time therefore, automatically relieve the pressure at the point where it hurts most.

The one point that labour seems unable to realize is that the price of their service, like the price of every other commodity, is regulated by the inexorable law of supply and demand. We cannot bolster up by resolutions or agreements or legal enactment any more than we can maintain the price of sugar or potatoes or any other commodity. If it is scarce and people want it and can afford to pay the price they will have it; if it is plentiful, and the demand slackens, the price goes down. It may be a relentless law but there is no man living, and no commodity on the market that is not subject to it.

## *The Effect of the Fordney Bill in Protecting United States Industry*

A detailed analysis of the permanent tariff (Fordney) bill recently introduced into the United States Congress shows its principal features to be:—

1. A very substantial advance in tariff rates.
2. Curtailment of the free list, which contains only 188 items, as compared with 270 items in the Underwood-Simmons tariff of 1913.
3. Resort in many cases where substantial protection is needed, to specific, or to mixed specific and ad valorem duties, rather than to straight ad valorem rates. This change is of special importance on account of the tendancy toward lower prices, as the duties will provide greater relaxive protection as prices decline.
4. A more detailed classification and subdivision of items so as to provide higher protection where such higher protection is required.
5. Total prohibition, for a period of three years, of importation into the United States of certain coal tar products, including dye stuffs, to be specified by the United States Tariff Commission when the Commission shall decide that such products of United States manufacture are obtainable "at reasonable terms as to quality price and delivery."
6. The adoption of the new system of "American valuation" for the assessment of custom duties, instead of the system heretofore in operation under which the ad valorem duties specified in the tariff were assessed on the fair market value in the country of shipment, and in practice on the invoice price.

Commenting on the bill, the New York Journal of Commerce says: "It is not easy to arrive quickly at definite comparisons of duties under the new and old lists, but duties are commonly thought by sharp observers to be not less than 30 per cent higher than heretofore."

The departure in the new tariff from the usual practice of asssessment of ad valorem duties on the prices paid by the importer for goods and adoption instead, as a basis for the levying of tariff rates, on the value of comparable goods in the United States, is a change of far reaching importance. In all cases the duties provided in the tariff to be assessed on the "American valuation" basis are equivalent to much higher rates levied on the old plan. Increased protection is afforded, especially against the products of low cost of production countries. For the purposes of assessment of duties, differences in the price of goods abraod will be ignored and dutiable value of imported merchandise will be the wholesale selling price of comparable and competitive products in the markets of the United States. Adoption of the principal of "American valuation" also will increase the protection to producers in the United States against imports from countries which, by reason of depreciation of exchange, enjoy a decided advantage in exporting to this continent.

This bill contains a special provision under which the President of the United States may enter into reciprocal trade agreements with foreign countries and, as a means of bargaining and for a quid pro quo, may concede a reduction during a specified period, not to exceed five years and to the extent of not more than 20 per cent of any of the duties prescribed in the new tariff measure.

In comparing the new tariff rates for the United States with those of the Canadian tariff, it should be noted that unless and until reciprocal agreements are consummated, the United States will have only a single tariff against all countries, whereas the rates usually quoted by critics of the Canadian tariff are the rates provided in the General Tariff schedule. Canada has, in effect, four tariffs: the General schedule, which is the highest and which applies to importations from countries the products of which are not admitted to the lower rates of the British Preferential Tariff and with which countries Canada has no special tariff agreement; the Intermediate or Bargaining Tariff, providing for reduced rates which the Canadian Government can offer to foreign countries; the British Preferential Tariff, applying to imports from the United Kingdom and other parts of the British Empire which make reciprocal concessions on importations of Canadian Goods; and special tariff rates such as those provided in the Canada-West Indies agreement.

In many lines the principal competition confronting the manufacturing industries of the United States is from the United Kingdom, so that the United States tariff rates in respect of such commodities should be compared, in measuring the relative protection afforded by the two countries to their home industries, to the British Preferential and not to the General rates of the Canadian tariff. It should be taken into account also that the primary industries of the United States have been much longer established than those in Canada, and that they are much more strongly developed. Consequently, a tariff rate on certain manufactured goods may represent the aggregate protection for a number of separate and distinct processes, whereas in the United States tariff it may represent the net protection for only one or two industries or industrial processes. For example, the Canadian tariff rates on manufactured commodities into which copper, brass or copper alloys enter as ray materials do not represent by any means the net protection for the manufacturer on such articles, but such rates constitute the combined protecion for the production of copper, the rolling of sheets or plates of copper, brass, or copper alloys, and the manufacture of articles into which such raw r semi-manufactured goods enter as raw materials.

## Canadian Chicago Bridge and Iron Co. is Now the Horton Steel Works, Ltd.

The Canadian Chicago Bridge and Iron Company, Limited, of Bridgeburg, Ontario, and Montrael, Quebec, has changed its corporate name to Horton Steel Works, Limited, according to an announcement made by C. H. Scheman, general manager of the company. The new name has been selected in honour of the late Horace E. Horton, who founded the organization in the United States in 1865. The Canadian organizatioinm was first incorporated in 1913, and the plant at Bridgeburg, Ontario, was constructed in that year.

Mr. Horton was one of the pioneer engineers of North America. Starting with a timber bridge at Orinoco, Minnesota, in 1865, Mr. Horton developed a large business in the design, fabrication and erection of bridges, steel tanks, etc. In the early nineties he revolutionized the steel tank business by inventing the hemispherical-bottom elevated steel tank of which thousands are now in use throughout the world. A few years ago his son, Mr. George T. Horton, now president of the Horton Steel Works, Limited, invented the elliptical bottom tank with riveted steel riser which was a further advance in the art of steel tank building.

The corporation has supplied the railroads and many industrial organizations of Canada with plate metal products. The company has a tried organization with its own operating officials, a complete plant, erection forces and contracting organization. In addition to Mr. Scheman, Mr. G. S. Sangdahl is district sales manager at Montreal, Mr. C. C. Gregory is manager of the plant, and F. E. Gregory superintendent of erection. The main office and works are at Bridgeburg, Ontario.

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A new book on belt conveyors has just been published by the Link Belt Company: It is book No. 215 and fully describes the Uniroll and Multiroll Idlers recommended by this company. Among the interestin features of the book are: (1) The correct methods of figuring belt conveyors and the details entering into them. (2) Price lists which will enable the user to determine the cost of a complete conveyor or any portion of a conveyor. (3) Numerous examples suggesting the correct type of belt conveyors for the handling of bituminous coal, by-product coke, sand and gravel, bagged sugar or similar material, crushed rock, etc. (4) In addition there are many illustrations of typical installations. The same company have just issued a new Steel Chain Data Book No. 475 in which is prested completely the heavier rugged steel chains used for power transmission, and also including elevating and conveying chains.

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The city of Swift Current, Saskatchewan, has appointed a business manager, to hold office for five years, having charge of the city finances and the power to appoint and dismiss civic employees.

# Is Testing and Inspection of Building Materials Essential?

### Structural Failures Prevented by Proper Inspection—Testing Company's Service is a Form of Insurance—Widespread Use of Concrete Demands Faultless Ingredients

By R. R. Deans, general manager, Canadian Inspection and Testing Co., Toronto.

The testing and inspection of building materials is to some extent looked upon by some architects and engineers as a novelty. Others place it in the same category as fire insurance and in some respects this classification is correct. We insure our valuable properties against loss by fire and the builder should insure his most valuable building materials against loss by failure. The engineer should guard his reputation through possible loss through failures, as such an instance, from whatever cause, attaches itself to the name of the engineer whether he is in any way responsible or not. The only time fire insurance is appreciated is after a fire ; similarly the time when the services of an Inspection company are appreciated is after a failure.

The necessity for testing portland cement before using it is recognised by the most up to date engineers and architects. It may be argued that if the cement be obtained from a firm enjoying a good reputation there is no need for tests. This is only partly true, as the best cement manufacturers make mistakes. Your protection is the individual test by a reputable firm of inspection and testing engineers. Faulty concrete cannot be taken apart, pulverized and analyzed with a view to ascertaining that it was the cement that was at fault. The cement must be tested before it is mixed with the other ingredients.

In connection with sand, some engineers may be able to say, from visual examination, whether or not a sand is carrying a high percentage of silt, but it is impossible to say what percentage of organic matter is present in the sand. The only proper method of accepting or rejecting a sand is by the laboratory test. Many concrete failures have been attributed to faulty sand. It may be said that the sand proposed has already been used in other structures with no ill-effects. However, all sands from the same pit are not equal in quality. Careless handling of the cover burden and failure to remove the clay pockets are two of the frequent causes of trouble. Sand is the second material in importance used in concrete, and no contractor or engineer or architect can afford to overlook the possibilities of trouble from that source. Many of the concrete failures that occur are attributable to improper sand.

Compression tests of standard cubes or cylinders of concrete taken from the forms immediately after pouring is a first class protection, as you obtain the actual compresion strength of the concrete as it stands in the work. Good cement, good sand and good stone may be made into poor concrete by faulty handling. The compression test is, therfore, the acid test of your concrete.

When we think of the important uses to which concrete is put, as for instance, foundations, floors, etc., we cannot fail to see the necessity of knowing the character of its most important ingredients and there is no doubt, whatever, that there are many instances of failure of concrete which have occurred which might have been prevented by a judicious testing of the materials before use. After a failure is the wrong time to commence to find the cause.

## Engineers of the Soo at their Annual Meeting

**Guests and members at Annual Dinner, Sault Ste. Marie Branch, Engineering Institute of Canada. Reading from left to right:—Judge** Stone; G. A. Montgomery; G. W. Goodwin; A. W. Sinnamon, M.E.I.C.; L. R. Brown, A.M.E.I.C.; W. C. Franz; C. H. Speer; S. B. [illegible], M.E.I.C.; Mayor Farquhar; B. F. Avery; A. G. Tweedie, A.M.E.I.C.; J. M. R. Fairbairn, President E.I.C.; C. [illegible]; J. W. LeB. Ross, M.E.I.C.; A. E. Pickering; C. M. Macreath, A.M.E.I.C.; F. F. Griffin, A.M.E.I.C.; L. L. Jacobs, Branch Chairman, A.M.E.I.C.; H. B. [illegible]; W. S. Wilson, A.M.E.I.C.; Fraser S. Keith, Secretary, E.I.C.; J. G. McLaurin, A.M.E.I.C.; J. D. Jones; F. T. [illegible], Jr., E.I.C.; F. Smallwood; W. G. Atkin; C. W. Holder, Jr., E.I.C.; Chas. Warnock, A.M.E.I.C.; W. J. Fuller, A.M.E.I.C.; W. [illegible]; C. H. E. Rounthwaite, A.M.E.I.C.; J. H. Jenkinson; G. S. Cowie; B. E. Barnhill, A.M.E.I.C.; E. E. Litz; C. C. Irvine; J. L. Lang; R. Olsendam; H. Buck.

# The Measurement of Plasticity

## Need for Some Standard of Plasticity to Establish a Basis for the Buying and Selling of Lime—Plasticimeter as a Device for the Investigation of Plastic Properties

By Warren E. Emley, before the National Lime Association

The difference in price between finishing hydrate and masons' hydrate ranges from one dollar per ton to seven dollars per ton. People are willing to pay the extra price for finishing hydrate, because of its greater plasticity. It would seem, therefore, that plasticity is a very important property of hydrated lime.

The definition of a ton has been the subject of much investigation and discussion, and finally of legislation. Our civilization has now reached the stage where everyone recognizes the commercial necessity of a standard of weight. Yet in the case of Minneapolis, 2640 pounds of mason's hydrate can be bought for the same price as a short ton of finishing hydrate. In other words, the value of hydrate depends as much upon its plasticity as upon its weight, there is, therefore, just as much commercial necessity for a standard of plasticity as there is for a standard of weight.

If any dispute arises between buyer and seller about the weight of a shipment, it is a simple matter to refer to the accepted standard and ascertain the truth. But if the dispute happens to be about plasticity, the question is usually decided by the personal judgment of a plasterer, which can be, at best, only his personal opinion.

### Need for a Standard of Plasticity.

As a matter of common fairness, to establish sound business relations between buyers and sellers of lime, a standard of plasticity is necessary. Another important function of such a standard is to facilitate investigations about plasticity. It is probable that the question of plastic hydrate would have been solved years ago were it not for the difficulty and uncertainty of interpreting the results by experiments. Suppose, for example, that a method is decided upon which should theoretically produce a plastic hydrate. It is necessary to make at least 100 pounds of material, give it to a plasterer, and rely upon his judgment as to whether or not the experiment is a success. This method of operating is so cumbersome that even the most industrious investigator is handicapped if not discouraged. Furthermore, he has no opportunity to learn by his failures; if the hydrate he makes is not plastic, it is practically impossible for the plasterer to tell him what is the matter with it.

The first successful attempt to supply this need for a means of measuring plasticity was made by Mr. Carson. His blotter test was described at the 1916 meeting of this Association. This method requires no expensive equipment and very little experience. The results are convincing and trustworthy. The writer uses this method entirely where the tests are for his own information only. Unfortunately the results cannot be expressed numerically, but only as a statement of the opinion of the operator. To overcome this difficulty, the present plasticimeter was designed. This may be considered as a modified form of the Carson blotter test, the personal equation having been eliminated, and the results made capable of numerical expression.

### Plasticity of 200 is Dividing Point.

The primary purpose of the instrument is to measure the relative plasticities of different hydrates. To determine how well it fulfills this function, hundreds of samples of hydrate, made by 71 manufacturers, have been examined during the past two years. These hydrates which have an established reputation as finishing limes, invariably give plasticity figures well above 200. The plasticity figures of those brands which are admittedly sold as masons' hydrate were invariably well below 200. Sub-committee 6, on plasticity, of Committee C-7, on Lime, of the American Society for Testing Materials, after a careful study of the method and the results, adopted this figure of 200 as the line of demarcation between finishing and masons' hydrates.

During the course of this work, several points of minor importance but great interest were brought out. It was found that different lots of the same brand of hydrate vary among themselves. In the case of a typical finishing or masons' hydrate, these variations are never sufficient to throw the samples into the other class. But there are on the market certain hydrates which we may call doubtful; the manufacturers call them finishing, but the industry is skeptical. It was found that the plasticity figures for these hydrates were pretty close to the 200 mark, so that the variations in quality from day to day, would throw them into first one class and then the other.

It has been established that a high calcium hydrate made in Vermont is a finishing hydrate. This effectually lays the old belief that the plasticity of a hydrate depends on its content of magnesium or of strontium.

During the past winter, Mr. E. E. Eakins, of the Charles Warner Company, has been conducting a series of very interesting experiments. He has been making mill sized batches of hydrate under predetermined conditions, having a sample of each batch tried out by a plasterer and sending a duplicate sample to Washington to be tested in the plasticimeter. The results of this investigation have been threefold: (1) The instrument was found to check the plasterer in every case, thereby establishing the value of the test; (2) Mr. Eakins is able not only to make a finishing hydrate, but is also approaching the position where he can control the plasticity of the product; (3) A distinct beginning has been made in the comprehension of those factors which cause plasticity.

### Other Uses for the Plasticimeter.

In addition to its primary function, the plasticimeter has become an extremely useful tool in other related investigations.

Mr. Hart, of the National Lime Association, has recently emphasized a very important point; the difference between fatness and wetness.

'It is quite possible to make a portland cement mortar as wet as a lime mortar, but it is quite impossible to make it as fat. The plasticimeter shows that plasticity is not dependent upon consistency; instrument measures fatness but not wetness.'

When a plasterer or mason adds sand to a lime putty, the quantity of sand is usually determined by the working quantity of the mixture. The plasticimeter, therefore, afford a means of measuring the sand-carrying capacity of a lime, and the lime-carrying capactiy of a sand An extensive investigation of the latter half of this subject has just been completed, and has brought to light some very interesting information about the qualities of plastering sands.

The wetness of a concrete can be increased by the addition of water, but the addition of lime will increase its fatness. An enlarged edition of this plasticimeter has been made to measure the plasticity of concrete, and judging from the preliminary tests, it would seem that we have at last found a means of determining just what the addition of hydrated lime does to concrete.

The plasticimeter is a new tool which can be used for the study of the plasticity of building materials. The investigation of this important property is responding to the new impetus, and developments are coming rapidly. Plastic silica and plastic asbestos have been developed on a laboratory scale. Plastic gypsum has passed this stage, and is now a commercial article. Here again, the results obtained by means of the plasticimeter have been checked and corroborated by the plasterer on the job.

# Fire-safe Roofs for Suburban Homes

## Use of Prepared Types of Shingles Now Permitted by Many Fire Regulations—The Status of Asphalt as a Roofing Material

By Prevost Hubbard

No building is more weather-proof or fire-safe than its roof. Any structure that is roofed with materials susceptible to fire or weather conditions is not only an uncertain investment but an actual menace to health and life. Fire plots its course from one inflammable roof to another and unless their are roofs that raise a barrier to the progress of the flames, the property owners of the neighbourhood are carrying a big fire risk, and the buildings constitute a great menace to the community.

That a realization of these essential facts has been driven home in recent years to real estate dealers, housing experts, home-owners, architects and contractors is shown by the tremendous increase in the production of patent roofing during the past twelve years as contrasted with the production of wood shingles in the same period. During this period patent roofing advanced from 8,200,000 squares in 1908 to 30,600,000 in 1919 while red cedar shingles slumped from 8,700,000 to 7,400,000 squares. The roofer's square equals 100 square feet.

There are in the United States over forty factories engaged in the manufacture of asphalt shingles and prepared roofing, representing with their allied interests an investment of more than $150,000,000. It has been conservatively estimated that the daily output of these factories exceeds 7,500,000 square feet of finished material. This daily output, if rolled into one sheet three feet wide, would stretch a distance of more than 500 miles, and would be sufficient to roof 4,000 dwellings of average size.

Twenty-five years ago comparatively small quantities of asphalt roofing were manufactured. Many roofs of this material, however, have lasted for over 20 years and asphalt shingles are now generally guaranteed for a period of 10 years. Time has demonstrated the durability of asphalt and its propensity to "stay alive," and not to harden unduly through loss of volatile oils. As compared with other bituminous roofings it shows less softening in hot weather and more pliability during cold weather. Construction and expansion under changing weather conditions have been found to give practically no trouble and there is little danger of cracking and breaking. The introduction of asphalt into the manufacture of prepared shingles has made the rapid advance in the use of the new roofings possible.

### Manufacture of Asphalt Shingles.

Asphalt shingles are usually manufactured of rag or asbestos felt, thoroughly saturated with asphalt. On top of this is placed a heavy coating of harder asphalt which thoroughly waterproofs the shingle and into which, while hot is rolled mineral matter, such as crushed slate or feldspar, coloured green, gray, red or brown as desired. This roofing is much less inflammable than the wooden shingle and its use is now permitted in restricted districts in which wood shingles are prohibited by the fire regulations.

When an asbestos felt is used in the manufacture of asphalt shingles they are extremely fire-resistant and "non-combustible" and take the same rate of insurance as slate, metal and tile. Slate weighs from 650 to 800 pounds per square foot while the tile weighs between 950 and 1200 lbs. The asphalt shingles average 220 pounds per 100 square feet or about the same weight as wooden shingles. Prepared roofing in rolls, varies from 35 to 100 pounds. The asphalt shingles wear for 10 to 15 years and do not curl or "lift up," blow off the roof or flap in the wind.

The graceful, free lines of a shingle roof have been so intimately associated from pioneer days with the architecture of houses that the shingle roof can almost be called the national roof for the American home. No roof construction offers so many varied effects or permits such artistic treatment as the shingle. The new home not only merits a roofing that will enhance its architectural beauty, but it should have protection from fire and permanence under variable weather conditions. This is made possible by the asphalt shingle. With a liberal field from which to make selections of color, shape and methods of application a roof of artistic appearance, as well as of long durability, can be chosen by the home-builder or the architect, from among the many types of asphalt shingles and other prepared asphalt roofings of which there is a wide variety, designed to meet different requirements. These sheet roofings are manufactured from woven or felted fabric saturated and coated with asphalt. They may be obtained either in flat sheets or rolls of suitable length, and of single or multiple ply fabric, according to the requirement of cost and durability. Some of the sheet roofings are surfaced with mineral matter such as sand, gravel, talc, slate and feldspar, some are manufactured with a laminated surface and some to imitate shingle structures of various designs. Many of these decorative roofings have become very popular in recent years and are less expensive than shingles.

"Roofing" constitutes an important branch of a much broader field of engineering, known as "waterproofing," in which asphalt has for thonsands of years played an important part. The ancient Egyptians were able to preserve their mummies in good condition to the present day by wrapping them in frabric saturated and made waterproof and weather resisting with asphalt. Modern ingenuity has discovered no material beter adapted to waterproofing and preserving its present day structures than asphalt. It is not surprising, therefore, that as in recent years the production of asphalt in large quantaties has been rendered possible by refining crude petroleum. Its use for roofing and waterproofing has developed rapidly. In many structures from roof to cellar asphalt plays an important part, first as roofing, then as sheating and insulating and finally as a waterproofing membrane for the underground portion.

## "Handbook of Construction" by Dana

A new book entitled "Handbook of Construction Equipment—It's Cost and Use" has been written by Richard T. Dana, consulting engineer, Mem. Am. Soc. C. E., Mem. A.I.M. & M.E., Member Yale Engineering Assn., chief engineer Construction Service Company, and is published by McGraw-Hill Book Company. Mr. Dana published the "Handbook of Construction Plant" in 1914 and the present volume is in lieu of a new edition. This book is valuable for an engineer or contractor as it will give him an accurate idea of what is available in the line of equpment, and what it costs and how to use it. The scope of the work may be gathered from the chapter headnigs, as follows: General Principles Applying to Equipment; Air Compressors; Asbestos; Asphalt Plants; Automobiles; Backfilling Machines; Bar Cutters; Barges and Scows; Bars; Belting for Power Purposes; Bending Machines; Bins; Blacksmith Shop Outfit; Blasting Machines and Supplies; Blocks; Blue Print Machines; Boilers; Brick Rattler; Buckets; Buildings; Cableways; Cars; Carts; Cement Gun; Cement Testing Apparatus; Chains; Chain Blocks; Chutes; Concrete Placing Equipment; Concrete Sidewalk and Curb Forms; Conveyors; Crushersl Derricks; Diving Outfits; Drag Scraper Excavators; Drawing Boards; Dredges; Drills; Electric Motors; Elevating Graders; Engines; Explosives; Fire Equipment; Forges; Forks; Forms; Furnaces and Kettles; Grading Machines; Heaters; Hoisting Engines; Hoists, Horses and Mules; Hose; Hydraulic Mining Giants; Jacks; Lead; Levels; Lights; Locomotive Cranes; Locomotives; Machine Shop Outfit; Mixers; Motor Trucks; Paint Spraying Equipment; Paulins; Photography; Picks and Mattocks; Pier & Foundation Equipment; Pile Drivers; Piling; Pipe; Pipe Line Tools; Plant Rental Charges; Plows; Post Hole Diggers; Power; Pumps; Rails and Tracks; Rakes; Refrigerating Plant; Riviting Guns; Road Making Equipment; Rollers; Rope; Sand Blast Machines; Sand and Gravel Washers; Saws; Scales; Scarifiers; Screens; Shovels; Skips; Sledges and Hammers; Sprinklers; Stone Boats; Stump Pullers; Surveying and Engineering Equipment; Tampers; Telephones and Telephone Lines; Tents and Tent Equipment; Ties; Tool Boxes; Tow Boats; Tractors; Trailers; Transites; Trenching Machines; Trucks; Unloading Machines; Wagons; Wagon Loaders; Welding; Wheelbarrows; Winches. Also an appendix showing a list of construction equipments manufacturers and dealers. Price $6.00, 850 pages, approximately 4½ x 7 inches in size.

## Resurfacing Worn Pavements with Asphalt

Since asphalt wearing surfaces as thin as one inch have been successfully used, their application as a material for covering worn pavements has been quite general. Intersecting pavements, car tracks and sidewalks, frequently limit the thickness of the new surface to a small dimension and in such instances asphalt has been most applicable.

Asphalt has been used to resurface bituminous types of pavements as well as brick, concrete, cobble, granite, gravel, macadam and nearly every type of pavement known. Up to two years ago, forty-three American cities varying in climate from that of Toronto, Canada, to Houston, Texas, had resurfaced some of their brick pavements with asphalt.

With a new level in cost of labor and material which it is predicted, will in coming normal times be higher than that of pre-war days, a salvaging of these old pavements as foundations must become a matter of great consideration on the part of engineers who are striving to design pavements upon sound engineering considerations.

Like any other structure, an ashphalt pavement will wear out and will need repairs. In the past officials have sometimes justified themselves in not adopting the hot mix types, because they thought it essential that a paving plant would be necessary to repair any openings made to reach underground services, or bad spots due to fires or improper manipulation during construction, and that the knowledge of constructing the pavements was so involved that they did not feel that their employees had the necessary experience to properly supervise the preparation of the mixtures and the laying of the pavement.

Happily these objections are now completely met. Many asphalt producers now make a satisfactory cold patch material which is sold in barrels and is used when needed and can be handled without special skill.

The supervising of plant and street operation and the selection of proper materials can with safety be placed in the care of any one of a number of experienced engineers and chemists who are making asphalt construction a specialty, and at a very nominal fee per square yard.

# Drill Steel From Hollow Ingots

## Tube Method is a Decided Departure from Old Schemes for the Production of Hollow Drill Steel and is Claimed to Result in a Product of Superior Qualities

By P. A. E. Armstrong, vice-president, Ludlum Steel Co. Watervliet, N. Y., before the American Institute of Mining and Metallurgical Engineers

Hollow drill steel is made by various methods. (1) The drilled billet with a filled sand-core, the general method used in this country. (2) The drilled, pierced, or the drilled and pierced billet, not sand-filled, is rolled down over a projectile or ball much the same as in ordinary pipe-manufacture. System (2) is largely employed in Sweden. In Sheffield, England, the general scheme is sand-filling. Swedish hollow drill steel is particularly good and has a world wide reputation for excellency.

It does not follow, however, that steels made by other methods are not efficient, because they are.

### Decarbonized Centres in Swedish Bars.

In the Swedish material, a peculiar condition is present. The hole is badly decarbonized by the method of manufacture and the extent of this carbonization varies in bars of different makes. Fig. 1 shows a polished and etched cross-section of very good grade swedish hollow drill steel that is totally decarbonized 1/10 in. deep, and the carbon varies from the carbon of the bar down to iron or corbonless ferrite through another 1/10 in. Owing to difficulties in illumination, the altered structure is not so prominent as under visual examination.

Fig. 2 shows a much lighter decarbonized zone, being only about 1/40 in. thick, but with certann radial cracks running from the hole into the bar. In this photograph it will be noted that the body of the steel is very dirty. There are a larger number of slag inclusions which follow somewhat the original form of crystallization.

Fig. 3 shows another section of Swedish hollow drill steel with about the same amount of decarbonization as Fig. 2 but with larger radial cracks, carrying the local decarbonization in more markedly than in Fig. 2. The zone of graded carboncontent is about three times the width of that in Fig. 2.

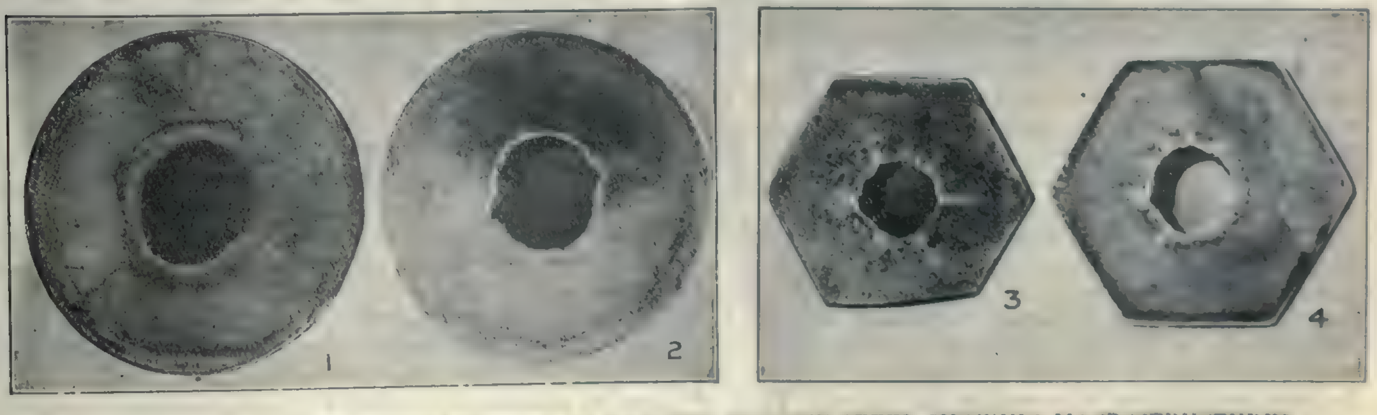
Fif. 4 is another sample of Swedish hollow drill steel, much about the same as the others, only with a little heavier decarbonization. All of the bars shown in Figs. 1 to 4 inclusive have been rolled either on a projectile or without one, but they were not rolled with sand in the role and represent the general run of Swedish hollow steel.

Fig. 5 is a piece of 0.85 carbon, 1 per cent chromium steel rolled from an ingot cast around a mild steel tube. The mild steel lining has a thickness of about 1/40 in. and there are no cracks into the tube from the metal. There is a slight, but very slight, grading in carbon content between this tube and the metal. The reason for this is that chromium present in steel as an alloy prevents to a very large degree the carburizing of adjacent iron by saturation. I do not say that it is not possible to carburize mild steel by saturation because of the chrome alloy, but merely say it is more difficult than when the chromium is not present.

Fig. 6 shows a piece of 0.85 plain carbon steel having the mild steel cube core, cast and rolled in exactly the same way as that in Fig. 5, yet there is very little of the carbonless iron remaining. A very complete saturation has taken place, which shows very distinctly the difference brought about by the chromiun.

### Influence of Decarbonized Layers

A question that seems worthy of deep consideration is this: Is this decarbonized core an advantage or a disadvantage? If it is an advantage why not duplicate this by controlled practice and not haphazard means of manufacture? If it is a disadvantage, then why is it that steel of this character has such a good reputation for being a good grade hollow drill steel? There is nothing in the steel that can be discerned microscopically or by analysis that proves it to be superior to hollow drill steel of good manufacture



FIGS. 1 TO 4 — ETCHED CROSS-SECTIONS OF SWEDISH HOLLOW STEEL SHOWING MACROSTRUCTURES

Fig. 1. First-class hollow steel rolled over a mandrel. Decarbonized zone 1-10 in. thick.

Fig. 2. Less clean hollow steel rolled over mandrel. Decarbonized zone 1-40 in. thick.

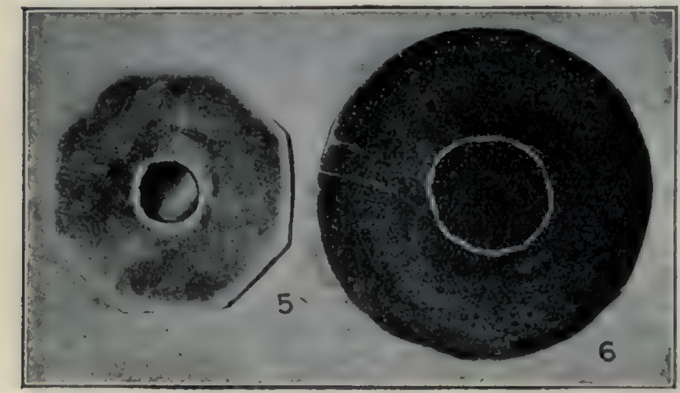
Fig. 3. Badly cracked steel with thick region of graded carbon content.

Fig 4. Heavily decarbonized rod of hollow drill steel

made by methods that prevent decarbonization of the hole. Therefore it is fair to assume that the decarbonized hole shown in the photographs, particularly in Fig. 1, has a much greater decarbonized rim in the hole than at the exterior of the bar. This probably may cause some wonder. I believe that it is due to the fact that on reheating the bars and rolling them through the various mills the oxide is broken off the bar. When the bar is reheated it is subject to a fresh scaling and is not affected by the scale already adhering to the bar which in itself would set up decarbonization. Therefore, the exterior of the bar has to withstand only the decarbonization arising from the furnace and later the adhering scale from that heating; whereas the inside of the tube is affected by adhering scale at all times, adding to the decarbonizing effects of the reheating. The scale is partly reduced by the carbon in the bar, and as the scale is thicker the action is more pronounced.

### Damping Effect of Decarbonized Iron.

The mild steel or decarbonized iron inside the hole acts as a damping effect when hardening is produced. This effect can probably be readily appreciated when the fact is remembered that if a piece of, say, 1 per cent carbon steel be rough-turned so that all decarbonization is removed from the outside of the bar and this be heated up to just above the transformation point and quenched in water of, say, 70 deg., the bars will come out hardened in spots in a non-uniform manner. Some places will be hard; others will not. If a further length of the same steel be rough-turned and then ground and polished, this bar, subjected to the same heat-treatment and same speed of cooling, will come out quite hard all over and not at all spotty. The reason for this is that the rough-turning holds the steam arising from the heated metal in contact with the water, and thus causes certain zones to cool at a slower rate than those places where the steam which is generated was quickly removed.



Figs. 5 and 6. Hollow steel rolled from chromium and carbon ingots cast around a mild steel tube.

In the case of the polished bar, there is no roughened exterior to hold steam pockets, and the steam, as generated, quickly arises to the surface of the cooling fluid and the bar is uniformly hardened over its entire surface. If this bar, which is polished, were covered with a thin tube, then the hardening would not be very pronounced underneath the tube. This of course would vary with the thickness of the tube and whether or not the tube was in good contact with the bar. Such a condition can artificially be produced by decarbonizing the surface of this polished bar. If this decarbonization is carried to a fair depth, say 1/32 in., the bar will not be of maximum hardness underneath the decarbonized area after being quenched in water. The thicker the zone the less will be the hardness, and for the same reasons which prevent one from hardening a piece of similar carbon steel right through to the centre when quenched from just above the transformation point. Another way of saying this is that the speed of cooling is only fast enough for a certain amount of penetration or depth of hardness. To harden right across the cross-section, alloy steels have to be resorted to, which have a greater lag to transformation.

### Hollow Steel From Hollow-Cast Ingots.

Hollow drill steel made by casting the metal around a tube and mechanically working the hallow ingot down to the required size (filling up the hole with sand and later removing same after rolling) will have an artificially produced equivalent decarbonized core which will be free from any such tendency toward splitting and driving in radial cracks as has been noticed in the photographs The surface of the inside of the tube will be comparitively smooth, giving a uniform cooling rate to the inside of the bar, again reducing the tendency for a radial crack. to start.

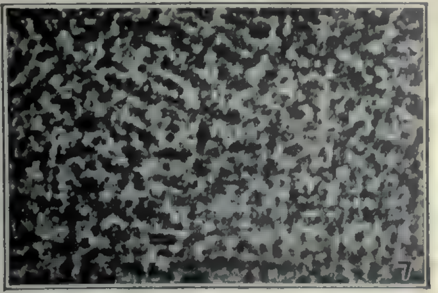
One of the reasons why the carbonless walls of the tube of the bars made by this method do not crack in manufacture is because the mild steel tube is not the result of a decarbonized steel highly impregnated by oxygen and oxides and having a number of microscopical holes where the carbon of the carbides last resided. These holes are places of weakness which may or may not weld up, depending on whether the interior of these microscopical cavities is coated from an oxide layer or filled with gas, either from the gas occluded in this steel or that which has penetrated from the furnace atmosphere. Decarbonized steel is, in my opinion, less strong than mild steel which has been originally made in low carbon and worked down to the required size.

The method employed by the Ludlum Steel Co. in the manufacture of hollow drill steel is to insert a high-grade low-carbon mild steel tube, suitably cleaned by sandblast, into an ingot mould and cast the hot metal around the tube. We fill up the tube with some air excluding material so as to prevent oxidization and scaling of the inside of the tube, generally using a high-grade sand for this purpose. The ingots are then rolled in the usual way down to the finished bar. The bars are cut up to required length and the sand extracted by a special method, which is very speedy and extremely effective.

### Segregation in Hollow-Cast Ingots.

Segregation is a thing which must happen in all steel solidification and this is responsible for a certain mechanical weakness in the finished bar. If the segregation can be so located as to have very little mechanical effect, it would be desirable to make the ingots in that manner.

Casting hollow ingots by the tube method is particularly fortunate in this respect. As the segregation which is bound to ocur will be concentric with the hole and its maximum occurence is about midway between the exterior of the ingot and the tube wall, this area is very large in circumference, comparitively speaking, and the segregation is comparitively small because the distance between the tube and the ingot mould is



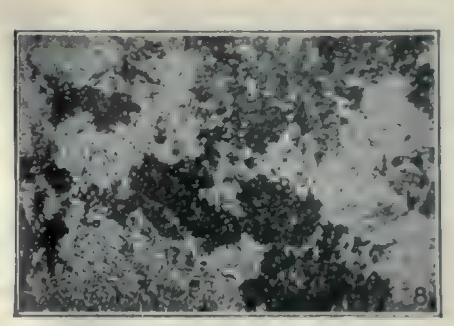


Fig. 7 (left). Structure of vanadium steel rod, picric acid etching. Magnified 30 diameters Fig. 8 (right). Same region magnified 400 diameters.

small. This thin layer of segregation will be most noticeable at the top of the ingot. It can have no effect, or at most very little effect upon the bar, as the segregates do not, under any circumstances, creep through to either the exterior or the interior wall of the ingot. Segregation is not removed at all in the pierced billets from solid ingots and is only very indifferently removed in the case of the drilled billet. Furthermore, even if segregated impurities are removed by using only the butts of the ingots, and drilling the billets, there is still carbide segregation to contend with. This will run in straight or nearly straight lines, parallel with the wall of the ingot or the line of freezing.

The inside of the hole of a drilled billet must, therefore, necessarily be the weakest place in the billet, resulting in a weak bar. Progressive fracture is easily started from one of these many sources of weakness.

### Influence of Crystal Size on Quality of Steel.

Crystal size is of great importance In a general way the smaller the ingot the better the steel. With a small ingot, the crystals are not very large, the crystallites or colonies of crystals not very far-reaching and the speed of cooling from the liquid to the solid state fairly rapid.

In a 24-in ingot, for instance, the crystallites are likely to be quite large and likewise the individual crystals forming them. Crystallites are also apt to have a uniform direction for quite considerable distances, depending entirely upon the temperature and speed of cooling. If the steel is cast hot enough and quickly enough, a fractured ingot will show a complete diagonal structure, the crystallites growing out like colums until they touch one another, leaving room for no equi-axed crystals in the centre of the ingot. If the temperature is lowered, the equi-axed zone is larger, and the pine tree growth, which is the crystallite formation, is less.

A small ingot, although capable of producing a very high-grade steel, is very prone to this columnar structure, even though the temperature of casting be kept down, and there comes a time when the ingots are very small, say 2 in. square or round or whatever shape is desired, when it is almost impossible to cast the steel in such an ingot without producing pine-tree growth. complete to the centre, and an ingot which is therefore known among workmen as "scorched." An ingot of about 7 in. size can be cast so that it is quite free from excessive pine-tree growth. Crystal formation, however, will be larger in a 7-in. ingot, cast solid, than where the 7-in. ingot is cast with a tube in it, as in the latter case one has all the advantages of a 2-in. square ingot with non of its disadvantages—the sandloaded core takes up the heat and prevents crystallite growth, besides preventing the formation of large crystals.

The speed of cooling after solidification is slower in the hollow ingot than it is in the solid ingot, therefore the granulation, which takes place after the crystals have formed from the lipuid metal, is apt to produce larger grains than in the solid ingot. This is not a dietriment. The original crystal size is of much more importance. The size of the grains due to this granulation constantly varies in response to mechanical work and subsequent heat-treatment.

I have found that the size of the grains arising from the granulation of the crystals does not grow larger than the size of the original crystal. Instances arise and should be carefully noted where the crystal boundary is broken and two crystals will appear as merely because the solutioin potential of both crystals are the same and therefore etch uniformly to the external boundary of the two crystals. This is more noticeable when these adjacent crystals have approximately the same orientation.

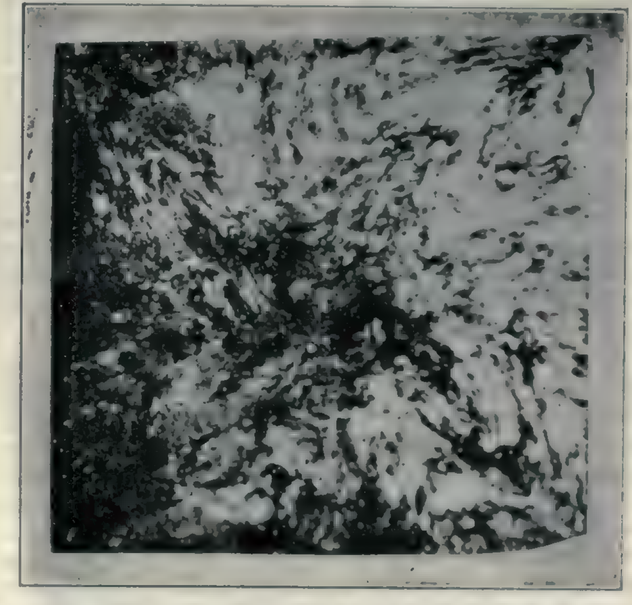


Fig. 9. Enlarged macrostructure of 3-8 in. alloy steel bar rolled from a 10 inch ingot enlarged eight times

Two very interesting photographs, Figs. 7 and 8, appear to show conclusively that the casting structure remains in the finished bar. The analysis of this sample is: Carbon, 0.90 per cent; vanadium, 0.25 per cent; manganese, 0.30 per cent. This steel was heated to 1,340 deg. F., a temperature just about its known transformation point, held for some time and then quenched in water. The piece was 1¼ in. round made from a 7-in. square ingot, having a very fine structure in the broken fracture, extremely tough and, generally speaking, a very fine piece of steel and for the tool for which it was used it gave some extraordinarily good results. Fig. 8 shows the structure as magnified but 30 diameters. Here can clearly be seen the cast structure, which has remained in the bar right from the ingot. I believe that this piece of steel, generally speaking,( will not have a crystal larger than the governing boundaries of the crystal from original casting. Naturally the crystals in this cross section. which is at 90 deg. to the direction of rolling, will be smaller in that direction than when originally cast, although their total volume will be approximately the same.

Fig. 9 shows a piece of ⅜-in square steel which was rolled out of a 10-in ingot. It is a high-alloy steel and particularly prone to the formation of long crystals, meeting others along the diagonals of the section. During the mechanical work the crystal formation has became somewhat distorted. The structure of the bar, as seen by a fresh fracture, shows this piece of steel to have a very fine grain; the polished surface etched in the ordinary way shows the grain size to be small. The crystal size is not clearly defined at first, but on prolonged etching the crystal structure of the ingot is clearly shown, while the grain outlines arising from the granulation of the crystal have been entirely obliterated. However, the inherent weakness of this steel has been laid bare by the prolonged etching with weak acid. This bar is obviously weaker along the originals diagonals. All the steel will show the original form in the same manner, no matter how far the working may be carried down; some steels have their crystaline structure more readily disclosed by prolonged weak-acid etching than others. It has often been noted that one bar of steel out of heat or a part of the haet will give very much better physical results than another bar from the same heat or out of a different heat, and this is to a very large degree due to the crystaline formation in the ingots. Fig. 9 very clearly shows the reasons for this condition.

Hollow drill steel made from a hollow ingot acording to our method is, therefore, a little safer to use when overheating has to be contemplated as a possibility, as the ultimate grain growth will be less than a similar sized ingot cast solid, for the simple reason that the crystals were originally smaller. I do not want to infer that hollow drill steel so made can be overheated and that then the steel will give the same satisfaction as if it were not overheated.. I am merely contending that it is slightly less harmful, the reasons being as given.

Surface weakness as shown by seaming and checking on the exterior when working the bars of hollow drill steel, or by cracking in hardening, is in some measure due to the surface stresses of the ingot when cast. We have found out that the temperature of the ingot mould or speed of freezing of the exterior of the ingot is of very great importance in this dircetion, and much seamy and cracked steel can be laid directly against a too quickly cooled skin. In gots that are turned or milled all over will not seem very much in working, in fact they are practically free from seams, whereas an ingot rolled without a preliminary machining operation is full of seams and cracks, some long and some short.

It has generally been said that these short seams and cracks in the surface of the bar are the result of elongated depressions in the surface of the ingot and that if an ingot is cast very smooth it should apparently give less surface defects. This is in some measure true, but an ingot cast very hot and having a very smooth skin will crack and seam very badly in the mill. The surface of an ingot poured very cold which is very crinkly, due to the low temperature of the metal, will seam just as badly. The cause of the cracks and seams in one is not the cause of the cracks and seams in the other.

Rough spots on the surface of the very slowly cooled ingot are elongated by mechanical work; roughened places continue to be pressed together, hence seams and cracks in cold-poured metal. In ingots cast very hot the pine trees of crystallites are separated by planes of great weakness at about 90 deg. to the surface of the ingot. These in themselves will cause cracks, the ingot then being known as tender. To draw the happy medium as a basis of our consideration and forgetting extremes, which are really of no moment, when comparing an ingot cast moderately hot so that it is not troubled with dendritic structure and an ingot cast somewhat cooler and having about the same smoothness of surface, there is practically no difference in the amount of seaming anc cracking, provided the ingot mould in both cases is cold or nearly so. If the ingot mould is warm, or thinner than usual, there is less surface strain on the resultant ingot and for similar surfaces there are less seams. Ingots cast with a tube in them seem to be freer from these surface stresses and the resultant billets do not have to be chipped or ground nearly so much to produce a bar free of seams and cracks.

### Internal Stresses

The smaller the ingot the less will be the tendency for surface seams or cracks which may or may not develop. Those that do not develop may be thought of as location of inherent weakenss. Steel will shrink about 3/16 to ¼ in. to 1 ft., and the steel as poured into the ingot mould will immediately freeze and contract to, say, one-half of the total shrinkage. As the inside of the ingot begins to cool at a later time, the solid surface is trying to maintain a larger area than is demanded by the lower layers. The exterior of the ingot must then be crushed or the walls sink in, in which case it is under tension in a direction normal to the surface. If the ingot mould wall is concave the ingot when cooling will come practically straight, therefore the surface of the ingot must be under tremendous compression and just beneath the skin of the ingot or the depth of the first frozen layer the steel must be under tension, being held under constraint by the outermost layers, already in high compression When the ingot is reheated it does not completely remove these strains, and when subjected to mechanical work the ingot will proceed to " let go " in various places—an action which will readily be conceded as being responsible in some measure for seams, cracks and defects under constructioin. The smaller the ingot the less the actual amount of shrinkage.

In a hollow ingot cast by the tube method the hole is increased in diameter by the freezing. The mild steel tube when heated up to the high temperature imparted by the cast metal is enlarged and continues to be enlarged untill it reaches a maximum temperature. It then shrinks while the ingot cools, thereby relieving the exterior surface of the ingot from cracking, or having as much strain as a solid ingot. The mild steel tube will witstand tis movement without givingway, whereas an ingot cast hollow without a tube will not be very good, since the inside of the wall of the tube would be first under tension and then compression, and the metal would withstand these complex forces less well.

The tube method of making hollow ingots for the manufacture of hollow drill steel is a decided departure from the old methods, and the logic of it seems to show that the resultant hollow drill steel should be superior to that made by the older method. Tests made by the Ludlum Steel Co. to date show that such is the case; whether or not our premises are accurate, we believe that hollow drill steel made this way will withstand alternating stresses better than anything that has yet ben produced of similar analysis. The reason why we believe the tube method of hollow drill steel manufacture is superior to the older methods are:

1. Greater freedom from extermal and internal straining.
2. Because of the inherent small crystal size.
3. Absence of harmful segregation resulting in weakness of the wall of the hole.
4. Less liability for the steel to crack in the inside of the hole during forging or hardening.
5 Toughening effect, arising from the mild steel wall of the hole limiting the intense hardening on quenching.

# New Type Steam Shovel

### Erie Shovels and Cranes Built with a Caterpillar Mounting that is Fully Lubricated —Increased Durability, More Power

For several years revolving steam shovels has been used on mountings of the caterpillar type, to provide maximum bearing surface over soft ground. This type of tread has a decided advantage for certain classes of excavation, especially for road grading where there are frequent move-ups over a soft floor.

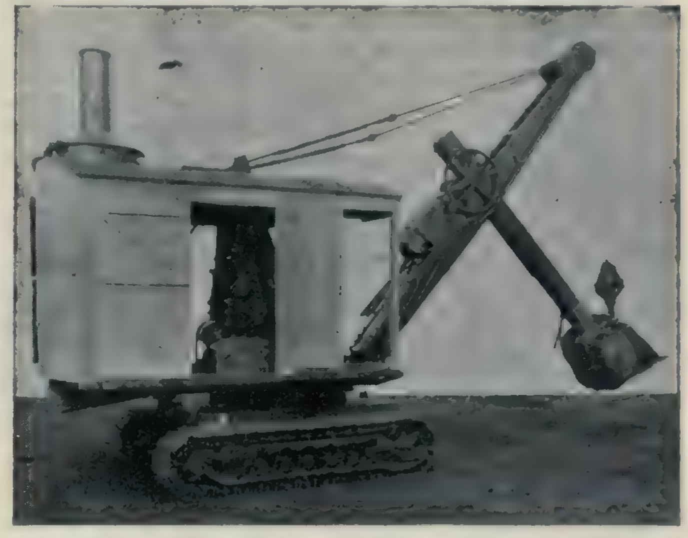
Erie shovels and cranes are now being built with caterpillar-type mounting that is fully lubricated, an improvement which is giving owners far greater durability than they have had with any other mounting of this type. The Ball Engine Company of Erie, Pa., builders of the Erie Shovel, have recently placed this mounting on the market after three years of experiment and careful test.

The durability of the new mounting is perhaps its most important feature. After a run of 100 miles, a caterpillar-type Erie is said to travel just as smothly as when new—whereas unlubricated mountings have often been known to wear out after moving less than forty miles.

On the new Erie mounting, every bearing is fully protected against undue wear by a film of special heavy oil, a lubricant which works equally well in hot weather or below zero. The link bearings are not allowed to run dry and "cut," but are protected like other important bearings on the Erie shovel. The Ball Engine Company, states that most of the trouble with various caterpillar-type mountings for steam shovels has been directly due to lack of lubrication.

Not only greater endurance, but far more traveling speed and climbing power result, from the reduction of friction in the new Erie mounting. A caterpillar-type Erie travels at a speed of more than a mile an hour on high gear—five to ten times as fast as an unlubricated machine. And the Erie climbs grades up to 25% on its own power. The surprising power, both for fast traveling and steep climbing, is due to the small loss of power by friction.

The lubrication of the Erie caterpillar-type mounting is easily taken care of. One filling of the oil reservoirs provides for at least a month's steady service. Once a month the operator spends about an hour in going all over the mounting with a squirt gun.


Type "B" Erie shovel on new caterpillar-type mounting

Another very important feature of the Erie's continuous-tread mounting is the perfect steering, controlled entirely by the operator from his regular position in the cab. The operator can turn sharply either to right or left or when desired can turn right about in one spot.

The Erie caterpillar-type mounting is easily interchangeable with ordinary traction wheels or standard gauge car wheels, on the same truck frame. The result is that any Erie on traction wheels can easily be changed over to caterpillar-type, and then later changed to car wheels if desired, without any alteration to the truck frame.

### New Book—"Highway Engineering"

Highway Engineering, by Geo. R. Chatburn, A.M., C.E., Professor of Applied Mechanics and Machine Design, and Lecturer on Highway Engineering, the University of Nebraska, Lincoln, Neb., published by John Wiley & Sons, Inc., New York. A book on rural roads and pavements, designed to cover the most recent and the best practice in road construction and maintenance. The scope of the book may be judged from the following chapter headings; 1 Good Roads a Business Proposition; 2 Road Location; 3 Types and Adaptation of Roads; 4 Drainage; 5 Culverts and Bridges; 6 Earth Roads; 7 Sand-Clay Roads; 8 Gravel Roads; 9 Broken-Stone Roads; 10 Pavement Foundations; 11 Brick, Stone, Wood and other Block Roads; 12 Concrete Roads 13 Bituminous Roads; 14 Surface Treatment to Mitigate and Prevent Dust; 15 Revenue Administration and Organization; 16 Miscellaneous.

# Standard Specifications for Wood Block Paving

### Recommendations Based on the Suggestions of the Principal Advocates of Wood Blocks, Coal Tar and Asphalt After Thorough Study of the Requirements

By S. M. Feinberg, C. E.

[Continued from last issue]

**25. Tar-Sand Cushion.** Tar-sand Cushion composed of approximately 10% tar, as specified under the heading for "Cushion Materials," and 90% dry, clean, sand shall be mixed cold and dumped on the base course. After raking the mixture shall be spread uniformly over the base, without rolling, and after tamping to a thickness not less than ¾ in. nor more than 1½ in; the mixture shall remain uncovered for a period of not less than 24 hours, and then the blocks shall be laid thereon.

**26. Asphalt Sand Cushion.** Asphalt sand cushion shall consist of a mixture of asphaltic cement as specified in paragraph N. 16, and hot dry sand or hot dry stone chips mixed in the following proportions: asphaltic cement, 5 to 7% and stone or stone chips 93 to 95%. Not more than 3% of the sand or stone chips shall pass a screen having 200 meshes to the inch, and all shall pass a screen having 10 meshes to the inch. The aggregate shall be proportioned from fine to course so as to produce a minimum of voids.

The sand and asphaltic cement shall be heated in separate heaters to a temperature of not less than 325 deg. F., nor more than 350 deg. F. The asphalt heating kettle shall be properly equipped with an approved agitating device thermometer so that the asphalt may be properly heated without injury to the material. The sand and asphalt or stone chips and asphalt shall be mixed thoroughly either in an approved hot mechanical mixer or in a concrete push car. The sand or stone chips and the asphalt shall be thoroughly mixed so that each particle of sand or stone chips shall be completely coated with the asphaltic cement until the whole mass is of a homogeneous consistency.

After the material has ben thoroughly mixed it shall be immediately spread upon the base course, which shall be absolutely clean and dry, to an average thickness of not less than 3 nor more than 4 ins. The mixture shall be spread with hot rakes and brought to the proper contour, after which it shall be immediately rolled with a hand roller, weighing not less than 25 lbs. per inch width of wheel base. The surface of the roller shall be kept lightly oiled in order to prevent picking up the cushion.

After the cushion has been thoroughly shaped and compressed by means of the hot rakes and roller, the blocks shall be set while the cushion is still hot.

**27. Cement Sand Cushion.** Upon the prepared base course, which shall be cleared of all loose and foreign materials and dampened thoroughly, there shall be spread a mixture of 1:4 cement and dry sand to to form a bed for the blocks, to a thickess of not less than ½ in. The cement and sand shall be mixed dry to a uniform colour, in an approved batch mixer, or if by hand on a clean, tight surface. The cushion shall then be shaped carefully by means of an improved templet and the entire surface of the bed shall be rolled with a hand roller, which shall not be less than 36 ins. in diameter, 24 ins. in width, shall weigh not less than 10 lbs. per in. of width, and shall have a handle not less than 12 ft. in length. The rolled cushion shall be sprinkled, immediately in advance of the block laying, with hand sprinklers or hose with a spray nozzle. No more cement-sand shall be mixed or prepared than can be used within any continous working period, and any bed upon which the blocks are not laid and rolled, during any continous working period, shall be removed and replaced with fresh materials when work is resumed. Cement sand cushion which is injured or displaced by flow of water, rain, or by any other cause, shall be replaced with new material, to the full satisfaction of the engineer in charge. The workmen shall not walk upon the cushion after it has ben shaped with the templet.

**28. Laying Blocks.** All blocks shall be laid carefully with best face up, from one one side of the pavement to the other side, in parallel straight courses at right angles to the center line, except at intersections and on curves where they shall be laid as directed by the engineer in charge. The blocks shall be laid with both ends and sides in contact, breaking joints not less than 2½ ins. The courses shall be straightened by striking lightly with a sledge on a 4 by 4 in. timber 3 ft. long, placed against every eight course, all thick blocks being removed. At the ends, and where necessary between courses, closures shall be made by carefully placing blocks cut accurately to give close joints.

Cut or broken blocks shall be used only at the ends of courses with the cut end turned towards the adjacent whole block; the cut or broken blocks shall be not less than three ins. in length. While laying blocks the pavers shall not walk or stand on the cushion, all the work of block laying being done over blocks already laid. Tamping or wheeling upon the cushion will not be permitted. The spaces between the blocks shall be kept clean and open to the bottom until the filler is applied.

In no case shall blocks, chipped to wedge shape, be used except on curves where absolutely necessary and only when permitted by the engineer in charge. After laying, the blocks shall be inspected once more, culled and approved for rolling, all defective blocks being removed and replaced by perfect blocks.

Experienced blocklayers only shall be employed in laying, cutting and trimming blocks.

**29. Corrugated Card-Board Spacers.** In case plain rectangular blocks are used, the contractor may, at his option, use single-faced corrugated card-board spacers, approximately 3/16 in. thick and 1¼ in. deep, extending the full width of the pavement.

**30. Rolling Blocks.** Before rolling, the pavement shall be inspected carefully and all defective blocks culled out after which the surface of the blocks shall be swept clean. The pavement shall then be rolled with a tandem roller, weighing, unless otherwise specified, not less than 2½ nor more than 5 tons,, commencing at the sides, and proceeding back and forth parallel to the sides, until the center of the pavement is reached; then passing to the opposite side, the rolling shall be repeated in the same manner until the centre is again reached, after which the speed may be increased, and the rolling continued until the blocks are bedded firmly. The rolling shall then be done, from one side of the pavement to the other side, at an angle of 45 deg., repeating this operation in the apposite direction. All blocks which are broken or injured during rolling shall be removed and replaced by perfect ones, which likewise shall be brought to the true surface. When a cement-sand bed is used, the surface shall be rolled immediately after laying, so as to complete it before the cushion begins to set. The blocks adjacent to curbing and other areas inaccessible to the roller shall be tamped to grade by the use of a hand tamper, applied upon a 2 in. plank. If the cushion is forced up between the blocks more than ½ in., the blocks shall be removed and the cushion reshaped.

After final rolling the pavement shall be tested with a 10 ft. straight-edge, laid parallel with the side of the pavement, and any depression exceeding ¼ in. shall be corrected, and if necessary, the entire surrounding surface again re-rolled.

32. **Filler.** Coal-tar pitch or asphalt filler, if used, shall be as hereinbefore specified under the heading for "Filler Materials," applied, unless otherwise specified, as described hereinafter for pitch-sand mastic filler.

The coal-tar pitch filler shall be applied at a temperature of not less than 250 deg. F. nor more than 300 deg. F.

The asphalt filler shall be applied at temperature of not less than 350 deg. F., nor more than 400 deg F.

32. **Pitch-Sand Mastic Filler.** The pitch-sand mastic filler shall be paving tar pitch as hereinbefore specified under the heading "Cushion Material" thoroughly mixed with as much hot ,dry sand as the pitch will carry, but in no case shall the volume of the sand exceed the volume of the pitch. The sand shall be fine and clean, all of it passing a 20-mesh screen. It shall be heated to a temperature of not less than 300 deg. F., nor more than 400 deg. F., and shall between these limits when mixed with the paving tar pitch, heated to not less than 250 deg. F., nor more than 300 deg. F.

The coal-tar pitch shall be heated in kettles properly equipped with approved thermometers, registering the temperature of the tar pitch. The mixture shall be flushed on the surface of the blocks and pushed rapidly into the joints while hot with squeegees or other suitable tools, subject to approval of the engineer in charge, reflushing or repouring, if necessary, in the opinion of the engineer in charge, until the joints remain permanently filled to approximately within ½ in. and 1 in. of the surface of the pavement, for non-bituminous and bituminous cushions respectively. All squeegeeing shall be done in one direction, without mopping back and forth and as little of the mixture as possible shall be left on the surface. No sand shall be swept into the joints between the blocks. prior to squeegeeing the mixture, unless so directed by the engineer in charge.

The pitch shall be delivered where directed by the engineer in charge in time to allow for examination and analysis.

In applying the filler care shall be taken that the blocks are clean and dry, that the pavers are closely folowed by the filler gang, and in no case shall the paving be left over night, or when work is stopped, without the filling of the joints being completed. In case rain stops the filler gang before its work is finished, the joints shall be protected by the use of tarpaulins or other approved means, in order to keep out water. Under no circumstances shall the filler be poured into wet joints

A top dressing of clean dry sand shall be swept into the unfilled space of the joints immediately after the filler is applied.

.33. **Asphalt-Sand Mastic Filler.** Asphaltic-sand mastic filler may be used in lieu of tar-pitch-sand mastic filler, as specified hereinbefore, except that in this case, asphaltic cement, as hereinbefore specified under the heading for "Filler Materials," shall be used and the sand shall be heated to not less than 400 deg. F. the sand shall be heated to not less than 400 deg. F., and the mixture shall be used only when it registers between 350 and 400 deg. F. All filler heated beyond 450 deg. F., will be rejected.

34. **Expansion Joints.** Expansion joints shall be formed along the edges of the pavement, next to curbs, against sidewalls of buildings and where street car or railroad tracks cross the streets transversely. In case non-bituminous cushion is used, transverse expansion joints, not less than 25 ft. apart shall be provided and installed. The joints shall be ½ in. in width, unless directed otherwise, and they shall be formed by placing together on edge two wedge-shaped wood strips 4 ins. in depth and each strip dressed on both faces. The strips shall be so cut that when placed in reverse positions, their total section shall be rectangular and of a thickness equal to the thickness of the required joint. The strip placed next to the pavement shall be set with the narrow edge up and the other one in the reverse position. These strips shall break joints and they shall be true to grade with ends tight, the bottom pressed into the bed and the blocks laid tightly against them.

The wood strips shall be installed before the blocks are laid and the back one loosened up as soon as filling is started.

Care shall be exercised to make the joint uniform in width and not ragged.

Soon after the filler has been squeegeed into the interstices of the pavement, the expansion joint strips shall be removed carefully so as not to disturb the blocks or break the bond of the filler, the joints shall be cleaned thoroughly to their full depth and then they shall be poured full, immediately, with a hot bituminous filler. These joints shall be repoured when necessary in the opinion of the engineer in charge.

In case premoulded strips of fibre matrix and bitumen or similar material of approved quality are used, the bitumen shall be heated from 225 deg. to 250 deg. F., at the time of its application. The joint material swabbed with hot bitumen on top shall extend through the entire thickness of the pavement. Care shall be observed in order to prevent the bitumen from spreading over the surface of the pavement for a width of more than 1 in. on either side of the joints. All joints shall be covered with clean, sharp sand before the pavement is opened to traffic.

35. **Blocks on Grades.** When the blocks are laid on grades of 4% or over, it is desirable that the method of separation for open joints on the sides of the block provide for a spacing between each course of 5/16 in.

36. **Curbs.** The curbs where indicated, shall be constructed of 1:2:4 concrete, 18 ins. deep, 6 ins. wide on top and 10 ins. wide at the bottom. All curbs shall be built to the established grade in a continous line, parrallel with the center line of streets except at all intersections of streets and offsets to buildings, where curbs shall be rounded to such a radius as the engineer

in charge may direct. The top and inside surface of curbs shall be given a smooth finish, complete to the point of each day's work.

**37. Curb Guards.** Headers subjected to transverse traffic shall have steel corner mouldings, of a type subject to the approval of the engineer in charge, forming a curved finish on the two exposed angular edges of the curb or header; where the curb is parallel to the direction of traffic and above the grade of the roadway, similar steel moulding shall be used where indicated,in order to form a curved finish on the angular edge nearest to the roadway. The outer exposed edge may have a curved finish on the concrete, corresponding to that of the steel corner moulding used at the inner edge.

**38. Miscellaneous.** Especial attention is invited to construction at existing man-holes and catch-basins and at points where railroad or street car tracks cross streets. Man-holes and catch-basins shall be raised or lowered if found necesary, in the opinion of the engineer in charge. Where railroad or street car tracks cross streets, expansion joints shall be provided and installed as specified hereinbefore and as indicated.

**39. Protection.** Immediately after the spaces between the blocks have been filled and while the filler is still soft and pliable the pavement shall be covered with a layer or approved clean, coarse sand, not less than ¼ in. thick, which shall be heated if directed by the engineer in charge. No traffic whatsoever shall be permitted on the pavement until the filler has cooled to the air temperature. This covering, kept wet, shall remain on the pavement for such time as may be directed by the engineer in charge, after which it shall be removed in a satisfactory manner to the engineer in charge.

In case cement-sand bed is used, the pavement shall be protected against traffic for a period of time to be established by the engineer in charge.

**40. Inspection.** All materials herein specified and processes used in the manufacture and creosoting of the blocks shall be subject to tests and inspection, acceptance of rejection at the point of manufacture, where there shall be provided all the necessary guages appliances and facilities to enable the inspector to satisfy himself that the requirements of the specifications are being fulfilled.

Attention is invited to the fact that a perfect penetration of every particle of sapwood is expected and a careful inspection of the blocks, after treatment, by sawing a number of the blocks, taken at random, through the center of the blocks and at right angles to the fibre, will be resorted to.

The purchaser shall have the further right to inspect the block after delivery upon the premises for the purpose of rejecting any of the blocks that do not meet these specifications, except that the plant inspection shall be final with respect to creosote oil and treatment.

**41. Items of Proposal.** Proposals shall be submitted to the engineer in charge upon the following items:

Item 1. For the use of tar-sand cushion in entire work complete, in accordance with the drawing and this specification, based on plain wood blocks, coal-tar pitch cushion and either pure bitumen or bituminous sand mastic filler.

Item 2. Amount to be added to the net price stated under item 1 for the use of lug wood blocks instead of plain wood blocks.

Item 3. Amount to be added to or deducted from the net price stated under Item 1 for the use of tar-sand cushion instead of coal-tar pitch cushion.

Item 4. Amount to be added or deducted from the net price stated under Item 1 for the use of asphalt-sand cushion, instead of coal-tar pitch cushion.

Item 5. Amount to be added to or deducted from the net price stated under Item 1 for the use of cement-sand cushion, instead of coal-tar pitcmh cushion.

NOTE: The specifications as drawn herein tend to cover average conditions only. Should circumstances warrant, other kinds of wood, such as North Carolina pine, Norway pine, black gum, tamarack, etc., may be used. Likewise, the melting point, penetration, etc., of the bituminous materials used should be modified to meet extreme climatic conditions. Should it become evident from laboratory tests conducted by the engineer that the moisture content in the blocks is higher than anticipated and there is a danger of shrinkage, the preliminary steaming treatment should be decreased, a fine sand filler, approximately ¼ in. in depth should be swept into the joints between the blocks, before the bituminous filler is poured, and the blocks themselves should be driven together as tight as possible, all in order to prevent trouble due to a possibility of shrinkage.

# Gravel Streets Made Capable of Carrying Heavy Traffic

### Committee Appointed to Report on Roads of the City of Grand Rapids Recommends the Use of an Asphalt Topping

The Grand Rapids (Mich). Engineering Society recently appointed a committee to investigate and report on methods of improving gravel streets with a permanent surface top, the committee to consist of H. H. Turner, Purritt A. Parks, Byron E. Parks, Theodore O. Williams, John. F. Nellist, C. A. Paige, T. H. Apted and C. J. Wagner. After an exhaustive investigation the committee has submitted a report in which it recomends the use of sheet asphalt or a bituminous penetration top. The report says:

In 1898 the practice was started in Grand Rapids of building and improving gravel streets having a combinaton concrete curb and gutter or a verticle stone curb. The roadway on this type of street was built in four seperate layers, totaling 10" in depth. The lower layer consists of cobble stones or large gravel where this could be obtained, and the voids between these stones was filled in with smaller gravel and clay. On each suceeding layer smaller gravel was used and after this the gravel was spread, the clay binder was put on and then the entire course was properly rolled.

"There was also a type of macadam street built which was of the same construction as the above described gravel street with the exception that crushed hard heads or lime stone was used as the base and limestone dust used as a binder instead of clay as above described.

"This type of street was an improvement in street construction over the old type of bank graved street which was built simply by spreading a layer of gravel over an unimproved street and when it became ull of holes another layer was spread. From 1898 untill 1918 75,083 miles of this type of improved gravel streets were built, but as early as 1912 it was discovered that with the advent of the automobile, the surface of these improved gravel streets would not hold up under the traffic which the automobile produced.

"The automobile traffic increased so rapidly during the last few years that in 1918 the practice of building gravel streets in Grand Rapids was discontinued and unimproved streets are now improved with either reinforced concrete ,sheet asphalt on a concrete base or brick on a concrete base.

"On account of the uniform way in which these improved gravel and macadam streets were constructed, the only objection to this type of street is that the automobiles destroy the surface of the street, which, of course,is not as hard as concrete or sheet asphalt causing the streets to become badly pitted, very rough for traffic, and very dusty in the summer unless properly treated with dust preventing material.

"The crushing strength of this type of street, or in other words its ability to carry satisfactorily a surface top which is not easily destroyed as is the gravel top itself, has been proven to be satisfactory under the modern auto and truck traffic and the object of this report pertaining to those improved gravel streets is the following:

"(1) Recomendations as to the types of top surface with which these improved gravel streets may be covered.

"(2) An appeal to the citizens of Grand Rapids who live on these improved streets to have these streets covered with a permanent top as soon as possible in order to improve generally the streets in the city of Grand Rapids.

"The most satisfactory type of surface top which which can be put on these gravel streets is that of sheet asphalt. In applying this the surface of the gravel street is first sacrificed and then re-rolled in order to restore as near as posible the oribinal contour of the street and to make its surface smooth in order to restore as near as possible the original conhas thoroughly dried the asphalt binder course of 1 ½" is applied and following this the 1 ½" of sheet asphalt topping is placed on the binder and the surface is then properly rolled to a smooth and even finish.

"The cost of this kind of topping is between $3.00 and $3.50 per running foot of property and arrangements may be made with the city to place this on a five year plan so that for a 40 foot lot the approximate cost would be from $24.00 to $28.00 per year for five years.

"With this type of topping it is safe to say that no maintenance work will be required on the street for at least fifteen years after the top has been put on. There are sheet asphalt streets in the city which have been down for twenty-four years, and undoubtedly the next twenty-four years will be harder on city streets than the last twenty-four years, but conservatively speaking fifteen years is plenty short enough for the life of this asphalt topping.

A second kind of topping which may be used on this type of improved gravel or macadam street is a bituminous penetration top and may be either a tar or an asphalt type of topping.

"In this type of top the base is prepared in the same way as above described for the sheet ashphalt top, but after the base has been prepared and properly rolled it is covered with 2½" of crushed hard heads or lime stone. Following this hot asphalt or tar, as the case may be, is poured on this stone which fills the voids and acts as a binder to hold the stones together. Following this a layer of smaller stone is applied on the bituminous material and it is then properly rolled and the entire top is bound together with tar or asphalt.

"After this first rolling has been completed the entire surface is then covered with a coat of hot tar or asphalt and a layer of pea gravel is spread on this surface coat which after being properly rolled finishes the surface and produces a very presentable type of top.

"The approximate cost of this is $1.75 to $2.25 per running foot of property which on a five year plan would cost the property owner for a 40 foot lot approximately from $14.00 to $18.00 per year for five years.

"There is, however, a decided difference in the wearing qualities of this type of topping as compared with the sheet asphalt in that approximately every three years a new seal coat of pea gravel must be put on this type of top. The approximate cost of this seal coat is 25c per running foot of property so that in the course of fifteen years in which nothing must be done with a sheet asphalt top, at least five coats must be applied.

"Considering both types of pavements it may be said that the ultimate cost at the end of fifteen years is approximately the same in each case, but during the fifteen years the asphalt pavement always presents a much better appearance and it is more satisfactory in every respect than the penetration type of street.

"It is safe to say therefore that between the two types of pavement the sheet asphalt in the long run is the most satisfactory and economical although the initial cost is somewhat greater than that of the penetration top.

"All of the members of the committee who have signed this report have made a personal investigation of the gravel street situation in Grand Rapids and are unanimously of the opinion that the report as rendered is the correct method of handling this large mileage of improved gravel streets which is being worn by automobile traffic. They are also of the opinion that this should be done as soon as possible in order to improve the general street condition in Grand Rapids.

## Large School for Walkerville, Ont.

Mr. Herbert E. Moore, architect, of Toronto, acted for Walkerville School Board as Judge of designs submitted for a fine, new public school, a Windsor firm of architects being the successful competitors.

The school is a modern adaptation of Gothic architecture, and contains 24 class rooms, auditorium, gymnasium and swimming pool. The building will be essentially Canadian in every detail, planned by Canadian architects and built of Canadian material by Canadian workmen. On account of Walkerville's proximity to the border, this determination marks a distinct departure from past methods in the district. The cost of this up-to-date school will be in the neighborhood of $450,000.

# Mainly Constructional

**East and West—From Coast to Coast**

The wages of the men employed by the Pressed Brick Company, of Galt, Ont., were reduced five cents an hour recently. The cut was accepted with scarcely a protest.

Winnipeg is likely to be selected as the site of a $3,000,000 factory for the spinning of flax, according to a recent statement made by Mr. R. J. Hutchinson, Chief of the Fibre Division of the Department of Agriculture.

A new course in town planning has been added by the University of Toronto and will be offered during the next two weeks, January 9 to 21, 1922. This new course has been initiated by Prof. Adrian Berrington, of the Department of Architecture.

A new firm, under the name Oro Cement Products, Limited, was organized at Barrie, Ont., recently, with a capital of $40,000 and will manufacture brick and cement products. The new company has taken over the plant of Wm. Adamson at Kempenfeldt.

A tender of $142,263 for the construction of an addition to St. Joseph's Hospital at Peterboro, Ont., has been accepted, and it is expected that work will be begun immediately. The new building will embrace the latest in hospital construction, and will double the accomodation of the institution.

According to present indications the new addition to the King Edward Hotel, Toronto, will be completed in time to take care of the large crowd of Exhibition visitors. The date originally set for the completion of the work was September 15, but excellent progress has been made and it is expected everything will be ready for the opening toward the end of August.

## Personal

Hon. Frank Biggs, Minister of Highways for Ontario, has announced the appointment of Engineer Philips, of his department, as resident road engineer for the Toronto district.

Assessment Commissioner Huesnergard of Kitchener Ont., has been elected chairman of the City Planning Commission, succeeding Mr. W. H. Breithaupt, who occupied the position for a number of years. Mr. Breithaupt will continue to act on the commission as vice-chairman.

Mr. Fred Brooks, Hamilton was elected president, and Mr. George T. Green, Ottawa, vice-president of the Canadian Association of Master House Painters and Decorators at the closing session of the convention held at Ottawa recently. Mr. William Paris, Toronto, is second vice-president, and Mr. W. Davington, Toronto, secretary-treasurer.

Mr. George D. McDougall, general superintendent of the Nova Scotia Steel & Coal Company, has been appointed chief engineer of the British Empire Steel Corporation, and Mr. Archie McColl, for many years secretary of the Nova Scotia Company, and assistant to the President, will be general Manager of the Nova Scotia Steel & Coal Company, according to official announcement made by Mr. D. H. McDougall, vice-president of the British Empire Steel Corporation.

Mr. F. E. Belfry, architect of the Ottawa Housing Commission, has been appointed city architect of Ottawa by the Board of Control and will tnter upon his new duties in August. Mr. Belfry, who was chosen out of a large field of applicants, is a dgraduate of the Toronto Technical School, having 22 years experience in all, 11 years in drafting and designing and 11 years in practical work. He has been architect for Ottawa Housing Commission for two years.

## Obituary

Mr. John B. Duthie, vice-president of Geo. Duthie & Sons, roofing and metal work contractors, passed away some days ago. Mr. Duthie was born in Scotland and came to Canada at the age of ten. He has reached his seventy-ninth year.

The death occurred recently of William Kennedy, formerly superintendent of public works, for Ontario. The late Mr. Kennedy had reached the age of 81 years, and for sixteen years had occupied this position. Previously he had been an engineering contractor.

Mr. Joseph P. Boucher, well known bridge builder of Ottawa, died recently at that city in his 71st year. Deceased was born at St. Timothy, P. Q. and for several years was a member of the contracting firm of Keating, Biggs, Wilson & Boucher, of Almonte, Ont.

The death occurred recently at his home in London, Ont., of Mr. John Purdom, one of the city's foremost building contractors. Deceased was borne in London 65 years ago and was engaged in the construction business until about a year ago, when he retired on account of bad health.

Mr. John H. Sprott, a veteran road builder of British Columbia, died recently at New Westminster, in his 81st year. Deceased was born in Scotland and came to Canada in 1870 and was appointed provincial road superintendent in 1878, which position he occupied for 35 years. Eight hundred miles of road, three hundred miles of trail and three hundred bridges were erected under his supervision during this period.

Mr. J. Emile Girard, C. E., superintendent and chief inspector of surveys, Quebec Department of Crown Lands and Forests, died recently while on his way to visit his two brothers at Chicoutimi, P. Q. Mr. Girard's death, which was quite sudden was due to heart failure. Born at Becancour, P. Q. the late Mr. Girard was admitted to the practice of his profession in 1890, and in 1901 appointed technical officer of the lands department; in 1907 he was named assistant superintendent, being promoted superintendent in 1910, and in 1911 was appointed Chief Inspector of Surveys for the province.

## Trade Incorporations

Reitzel's, Limited, with head office at Waterloo, Ont., capital $125,000, to manufacture and deal in building materials.

Beaver Building Co. Ltd., with head office at Montreal, capital $1,000,000, to carry on the business of a general construction company.

Westmount Construction Co. Ltd., with head office at Montreal, capital $15,000, to carry on a quarry business, dealing in stone, sand cement, etc.

## New Sauerman Booklet

No. 15—" Sauerman Dragline Cableway Excavators for Handling Earth, Clay, and Sticky Materials"—This booklet, in text and illustration, explains how this equipment can simplify the moving of clay and earth through its ability to work over a long span and dig, convey, elevate and dump materials in one direct operation, under control of one man.

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## *Labor's Uncompromising Attitude Will Hamper Building in Toronto*

The second conference between the employers, manufacturers and employees in the building industry at Toronto scheduled to meet July 25th, to receive the answer of the various labour organizations to the suggestion of a 10 per cent. cut in wages, merely reresulted in a flat refusal on the part of labor to make any concessions. It is very unfortunate, we think, that labour should have taken so uncompromising a viewpoint of the situation, for it is entirely reasonable that this attitude will retard building to a very considerable extent and that the ultimate result will be a much smaller income to the average workman. A year ago, the majority of people were convinced that we had reached a new standard of high prices that would be maintained for all time. To-day they are just as firmly convinced that we are going to get back in a comparatively short time to the conditions of 1913 and 1914. That being the case, people will not build, except under the greatest pressure. Neither will they buy, fearing a depreciation in the value of their property during the next couple of years. The situation is rendered still more critical by the difficulty of borrowing money for building. First mortgages are obtainable up to perhaps 50 per cent. of the value of the property, at a fairly stiff rate of interest, but second mortgages are almost impossible to obtain and the conditions, where they are obtainable, are very exacting.

Under the circumstances it is difficult to see how the present wages in the different trades are to be maintained. The Executive of the Builders' Exchange have an agreement with a number of the trades which has some time yet to run. There is no doubt that the members of the Exchange will endeavour to stand by their agreement, knowing full well that it is not in the interests of the building industry. It is to be hoped that the men will see the situation differently as time goes on and for the general good—including thier own—release the contractors from their agreements and so open the way for a revival of building. This is all the more to be desired when we consider that the building and construction industry is a basic one and that the activities of all other industries are very largely measured by it.

## *Period of Business Disturbance is Over, Claims Financial Authority*

The National Bank of Commerce, New York, has issued a quite optimistic report on business conditions. According to their statements the United States is practically through the period of violent business disturbance which began in May, 1920 We will from time to time have visible evidence of the distressing conditions through which the country has been passing, but these occurences should be regarded not as indices to forward conditions but as relating to the past. The changes which have taken place have not as yet been recognized by the business public for two main reasons. The period of normal midsummer dullness now at hand has obscured the certain evidences of improvement and there has been lacking a thorough comprehension of credit conditions.

Failure to recognize the passing of the period of insufficient credit has resulted from lack of recognition of the fact that for a long time the credit shortage has been apparent rather than real and due in large part to the unsatisfactory character of some of the risks offered. There is now no bank credit available for operations designed to hold prices at fictitious levels. Orderly organized marketing, if fair, succeeds, but attempts to hold up prices above the levels determined by international supply and demand are certain eventually to fail. American business and government alike have thus far kept clear of entanglements of this character, but even so, American business cannot avoid their indirect effects. Valorization schemes providing for immediate holding for arbitrary prices of such commodities as wool, silk, coffee, sisal and sugar, if successful, would involve the purchase by American consumers of raw materials at levels likely to involve ultimate loss, and as long as these plans contemplate the maintenance of an artificial price they cannot be disregarded in consideration of credit risks.

Some businesses have found difficulty in getting what they have felt to be a fair line of credit. This has been because of a desire to operate on a basis of inventories of raw materials and goods not yet written down or because in these instances heavy investments have been made in plant and equipment at inflated prices. In such cases they are not yet willing to admit that they will have to take their losses and adjust their operations to make profits on real values only.

Although occasional failure to secure desired credit accommodations has served to keep alive the impression that there is a shortage of bank credit, the truth is that there is now available a volume of credit larger than present business requires. The main requisite for a return toward normal conditions is the will to try for business on a level where it can be had. The period of general liquidation of the raw material markets of the United States has passed. Recent declines are due to conditions of supply and demand in specific lines. This is a normal condition. Wholesale prices of many classes of manufacture have been fully deflated. This is not true in all lines, but recent cuts in the price of steel and widespread reductions in wages indicate that adjustment in wholesale prices will not be long delayed. Retail prices show wide irregularities, and high-cost stocks have been largely disposed of. Price stabilization is, therefore, not far ahead.

## Annual Picnic of Winnipeg Builders' Exchange is Popular Event

Members of the Winnipeg Builders Exchange and their friends to the number of over 1500 spent a most enjoyable time at the annual picnic held at Grand Beach, Manitoba, on July 16th. Early morning Canadian National trains were crowded, and many more went in the afternoon. As soon as possible after arrival at the rendezvous a start was made with a comprehensive programme of sports, and these were carried through with an intermission for lunch. The morning was devoted chiefly to the children, who had a wonderful time. Committee men and others devoted themselves entirely to seeing that the juvenile lacked nothing to ensure their complete happiness on this occasion.

In the afternoon the adults had their turn and the earnestness shown in the many events lacked nothing of the vigor displayed by the little ones. One of the most interesting events was the search for the "Mysterious Contractor" who walked about carrying in his pocket a small document which would entitle the fiftieth person shaking hands with him to two cords of wood. This mysterious personage turned out to be John McDiarmid, who was so well know that very few deemed it necessary to shake hand with him. Only about 25 did so, thus, as the prize was not won, the committee generously donated it to the Old Folks' Home.

## Montreal Firm Develops Engineering and Contracting Business

The investment house of H. L. Coombs Co., Limited, Montreal, announce, that they have added three new departments to their business, namely, pulp and paper machinery equipment, pulp and paper products and also an engineering and contracting department.

A special effort is now being made by several Canadian manufacturers to supply pulp and paper mills with Canadian-made machinery, as it is felt that the more business that is placed with Canadian firms, the better it will be for business generally and for the employment of skilled labour. John C. Corcoran, formerly of the Dominion Engineering Company, will be in charge of this department. Mr. Corcoran has some thirty years' experience in this line. His assistant, Mr. P. E. Buss, formerly of the Provincial Paper Mills knows the business and trade thoroughly.

The magnitude of the pulp and paper business in this country is growing rapidly, and to secure a part of the foreign business that is offered, this firm has secured the services of Robert Rolland, lately connected with the export department of Messrs. Grace & Company. Agency connections are being established in India, China, South America, Australia and Europe, and in addition to looking after this foreign demand, the domestic business will be taken care of in all lines of pulp and paper products.

The engineering and contracting department will be in charge of L. N. Jenssen, who has had an experience in several parts of the world in railroad construction, bridge building and concrete work. Mr. Jennson expresses the opinion that this is an age of concrete, and that bridges and other constructions made of this material are more serviceable and inexpensive than when made with any other material.

The company's other activities at the present time include the development of Plateau Laviolette at Three Rivers, where an extensive building campaign is going on, and also the laying out of Otty Lake Park, one of the chain of the Rideau Lakes, near Perth, Ont., as a summer resort, as well as the mining of feldspar, phosphate and mica, which minerals are found on the same property.

## British Highway Development

The British Ministry of Transport has issued the tenth annual report of the road improvement fund covering the year to March 31, 1920. A grant was authorized in December, 1918, by the government to assist highway authorities to cover arrears in road and bridge work which had accumulated during the war.

In the meantime the Road Improvement Association has criticised the ministry's delay in making grants to local authorities for road improvement and maintenance on the ground that, although nearly £8,000,000 has been gathered in motor taxation, none of this amount has so far been allocated. In reply the director-general of roads says that the financial year of the local authorities began on April 1, and that, as grants are only to be made quarterly and not in advance, the first payment is not due until July 1.

The system suggested on which payment should be made is that the certificates of expenditures of the local authorities, when passed by the Ministry of Transport, will be honoured to 90 per cent, the remaining 10 per cent being paid at the end of the financial year.

A sum of £1,250,000 has been allocated to the arterial roads scheme, and £1,750,000 for main roads during the current year will be borrowed from the Treasury..

Some concern is felt for the future road policy in England. It is generally believed that the Ministry of Transport will cease to exist with the decontrol of the railways which is due next August. In some quarters it is suggested that the roads department be taken over by the Board of Trade, as the general policy of road construction is widely approved.

It is fast becoming evident that the growth of road transport has overtaken the existing highways, and it is urged that some authority must be created to control and pursue the laying out of new arterial roads, the co-ordination of road construction and repair and maintenance of roads on a national basis.

# Should Road Contractors Buy or Hire Motor Trucks?

## Motor Haulage Contracting Firm Denies the Allegations of Some Truck Salesmen that Road Builders Can Profitably Operate Their Own Equipment—Motor Haulage is a Business that Should be Left to Specialists

Editor,Contract Record:

In your issue of June 22 you had an article entitled: "Should Road Contractors Buy or Hire Motor Trucks?"

As haulage contractors, you may take it from the first that this reply is in the same class as the opinions expressed in the aforementioned article, wholly interested.

We know that truck salesmen have, so far as this year is concerned, practically filled all the orders they are likely to get for motor trucks from haulage firms, and they yearn for more worlds to conquer; and as their remains now only road contractors themselves to sell trucks to, this article would appear to be one of the first shots in the campaign to that end.

So far one of the prime arguments of truck salesmen to induce haulage firms, or would-be haulage firms, to purchase trucks has been the argument of all the work that could be secured from road contractors; but since that argument is now apparently played out for this year, it is being replaced by the other one that is being made such a point of in the article.

Since being in the haulage business, we have heard more bunk from a certain class of truck salesmen as to the cost of haulage by motor truck and more irresponsible statements regarding the profits that can be made than from any other line of business men we have ever met, and we are finding that it is not real businesslike competition that we have reason to be afraid of now and in the immediate future, but ignorance of actual costs of operating trucks on the part of would-be haulage firms whose only information is that supplied by truck salesmen, only about five per cent. of whom know a thing about the actual cost of operation and the economic value under specific conditions of the tool they are selling.

### Salesmen Ignorant of Transportation Problems.

We would emphasize at this point that we are not condemning all truck salesmen, for so far as the truck firms and salesmen are concerned, with whom we have completed any business, we have found them both helpful, reasonably conservative in their statements, and practical both in their knowledge and analysis of transportation problems, but this we have found to be very, very rare.

Practically every truck-selling firm doing business in Canada, and some from the States, have touted us for business, and as we make a point of listening to all so that we can keep well abreast of the times on points of new equipment and efficient methods of doing business, believe us, we have listened to some weird statements of costs and profits.

Your article of June 22 contains two very beautiful and typical truck salesman statements, as well as a gross libel on the legitimate firms doing a legitimate and reputable business. One states:" A firm secured one of our two-ton trucks, and in thirty days' work, practically paid for the truck itself."

It is reasonable to suppose that this particular cost $2,000 anyway. Can a two-ton dump truck earn $2,000 gross in thirty days work at a similar rate per day, ton mile, yard mile or other unit price that the same work could be sub-let at to a reputable haulage firm? **It can not.**

We operate five-yard high grade equipment costing over $9,000 per truck; we have now and always have had properly profitable and reasonably continuous work,much more so than any single road contractor has so far as the continuous end is concerned, and no single truck of ours has ever earned $2,000 gross in thirty days, or anything like that sum. Never mind having made that much profit, which the statement implies, and notwithstanding our equipment having three times the carrying capacity of the two-ton truck aforementioned.

The second example of truck salesman statements is as follows: " We have noticed cases where road builders have taken contracts for construction work at a price lower than the actual cost of hauling gravel to the point of work."

What kind of road builders? Probably ex-truck salesmen putting into practice their knowledge of contracting.

The same writer states that " The hired truck contractor does not bear the same measure of responsibility as the road contractor. He is dependent on transient employment to make a living and for that reason he does not care to assume the responsibility of fulfilling his contract to the letter, etc., etc., and as a rule when he finds he is not making money on the job, he breaks his contract and the road contractor finds himself in a pinch."

We suppose everything goes kicking, biting and scratching, but we take exception to this gross libel on ourselves and other firms who pride themselves on doing a reputable business, and we should like to know to what class of people has this man been selling trucks, if that is his opinion of their methods of doing business.

The only opinions which have sound common sense behind them sum up the situation as follows:

1. "In our opinion it would be inadvisable to make any blanket statement covering the subject. It has been our experience that the merits of each particular case must be fully considered, whether rented

or owned equipment, would be most profitable in any specific situation."

So far as the firm, whose representative made that statement, is concerned, we know for a fact that they will give an honest opinion, and have known definite cases where they have advised contractors to buy and other cases where they have advised them against buying trucks, as when all things were considered governing the case, it was more profitable to the road contractor to hire his equipment from a reputable haulage concern.

The second opinion which has sound common sense behind it is as follows: "We are personally becoming more and more of the opinion that motor truck operation is a business of its own the same as the other large agencies of transportation."

He is right. It is now to some extent, and will be more so at time goes on, a special line of business, and very few general contractors with their multiplicity of interests and worries can now, or ever will, operate their own trucks at the same costs as the same firm doing nothing else, and reasonably profitable as it is under efficient management, there is not sufficient margin between costs and earnings to allow of any contractor falling down very much below an efficient haulage firm's standard and still leave him any further ahead after increasing his capitalization considerably by buying motor trucks.

We notice that most of the opinions quoted are from firms who "assemble" trucks, that is manufacture practically nothing on the trucks they sell, but buy a rear end unit from one firm, engine from another, exles and bearings elsewhere, etc., etc., assemble the whole thing and sell it as such-and-such truck.

Why? Surely the particular firms supplying these different units must make profit on them, and also surely the profit is being lost to the assembling firms just in the same way that the road contractor is losing money through hiring trucks, as per the truck salesman's own statement.

Then why? For the same reason that the road contractor hires truck equipment, namely:

1. Most people in business have only a certain amount of capital they can use in it, and have to allow the other fellow to make a reasonable profit out of such capital as he can use.

2. Most people in road contracting have no assurance of contracts year after year that justifies more heavy capital expenditure on their own part.

3. Most people in road contracting know that the argument given in the article of June 22 that they could use their trucks for one or two years and then sell them, still leaving them a profit on the operation, is not sound, and that the only profitable way to operate this class of equipment and leave any profit behind is to secure sufficient work for them and in due course wear them out.

4. Most people in road contracting know that there are reputable concerns in the haulage business whose word is as good as their bond, have a good efficient organization, are out to give real service as good as a road contractor could give himself with his own equipment, and have high grade equipment to do it with. They also know that high grade haulage firms and high grade equipment run together in pairs, are content to know that no one firm can make all the money in the world, and are satisfied for the other fellow to make a dollar provided he gives honest to goodness value for it.

Yours truly,
MARSH & MORRISON,
Heavy Cartage Contractors, Toronto.

# Where Nature Makes and Seasons Asphalt

## An Interesting History of the Discovery and Development of the Wonderful Natural Reservoirs of Asphalt in Trinidad and Venezuela—A Perfect Product Constantly Replenished

By Harold T. Macfarland, Aldan, Penna.

Created in Nature's laboratories in South America, close to the equator, by a process which extends over ages and utilizes to the fullest measure the seasoning powers of tropical sun and storms, native lake asphalts to-day are binding pavements together that carry heavy traffic on hundreds of miles of city streets and country roads in many parts of the globe.

No more striking proof of the thoroughness of Nature's own manufacturing process is found anywhere, than in the uniformity of the material from the world famous Asphalt Lake in the Island of Trinidad, British West Indies. The asphalt from the neighboring deposit, the Bermudez Lake, in Venezuela, varies considerably in the amount of water it contains, but the material selected for use industrially is constant in character, also further demonstrating the excellence of Nature's methods.

The value of this gift of two great deposits of the World's most efficient water, wear and weather proof material is being realized more and more, as the range of uses widens. Utilized first more than forty years ago, as a paving material, asphalt to-day is gaining in importance in all lines of industry, being used as a flooring material, for tank and pipe linings, for roofs and other purposes.

At constantly changing points on the surface of the lakes toil gangs of labourers, flaking out great lumps of asphalt that the needs of mankind for smooth, durable, resilient highways may be met. Development of the asphalt industry in Trinidad and Venezuela has changed places of beautiful isolation into scenes of activity.

### Discovered by Columbus.

Columbus on his third visit to the new world in 1498, discovered the island of Trinidad. As the three high peaks rose above the blue waters of the Caribbean, the discoverer bestowed upon the Island the name it bears in honour of the Blessed Trinity.

Columbus, too, was the discoverer of the asphalt lake. History records that the Spanish mariner expected a land scorched and fruitless, but does not reveal his expressions upon sighting the lake of natural bitumen in the midst of luxuriant tropical growth.

Raleigh, a century later visited the island and employed asphalt from the pitch lake to caulk his leaking vessels, finding it extremely satisfactory for the purpose.

The Island of Trinidad under Spanish rule saw a series of conquests of the native Indians, importations of slaves, warfare and bloodshed. Pirates infested the coves, and preyed upon merchantmen attracted by the output of the fertile island. In 1797 England conquered Trinidad, and to this day it remains part of the British Empire.

Trinidad lies off the north coast of South America, and is bounded on the north by the Caribbean Sea, on the East by the Atlantic Ocean, on the south by a narrow channel into which flows the waters of the northern and most Western mouth of the Orinoco; and on the west by the Gulf of Paria. That Trinidad is intimately connected with the South American mainland, is proved not only by the long promontories, but also by its geology and fauna, the latter corresponding closely to that of the mainland, and the geological structure being clearly a continuation of that of the continents.

The Asphalt lake is on the north side of the south western peninsula, about 28 miles in an air line from Port of Spain, the capital and only port of entrance of the island. The point on which the lake is situated has been protected by the bituminous deposit from the ravages of the sea which elsewhere rapidly is wearing away the cost.

### Crater of Extinct Volcano

Studies of the phenomenon appear definitely to have established the fact that the asphalt deposit occupies the crater of an extinct mud volcano. The lake is a nearly circular area, covers about 114.678 acres, and is 138 feet above the sea level. Around it range low hills while the surface is dotted with " islands " or clumps of low trees and bushes.

There is no uniform expanse of asphalt such as many visitors expect to find. Neither is there intense heat or noisome odors, bubling liquid or parched surroundings. The main expanse of asphalt is made up of separate areas, irregular in outline, and separated by channels of from a few inches to several feet in depth, in which rain water collects. Around the edge grass and shrubs may cover the asphalt for several yards.

### In Constant Motion.

The asphalt itself is dull bluish gray in color,. The entire deposit is in constant motion, although days of observation is necessary to show this fact. The folds in the asphalt take the place of waves, and sticks which emerge erect at the centre gradually increases their direction from the perpendicular as they travel toward the edge. The islands themselves move about from place to place, the period of change extending over weeks.

Trinidad asphalt is an emulsion of water, gas, bitumen and mineral matter, the latter consisting of fine sand and a smaller amount of clay. The constant evolution of gas is responsible for the motion of the deposit.

In the centre of the lake there is a slow but continous influx of soft material which gradually hardens with age and becomes like the main mass of the lake. The body of asphalt is hard enough to support a narrow railway and gangs of diggers, but soft enough to settle until any holes dug in the surface disappear.

The explanation of the asphalt deposit now generally accepted is that far below the surface of the earth oil is concentrated, and slowly forced to the surface through strata of sand and clay by the constant pressure from the sides. The slow, churning action of petroleum, sand and clay mixes all together, and the result is asphalt. High temperatures apparently are not necessary, but time is essential.

### Constantly Being Replenished.

Strenght to the theory that new asphalt is constantly coming into the lake, either at the centre where the most gas is evolved, or far underground, is lent by the fact that despite the removal, during the last forty years, of several million tons of material for paving operations, the surface of the lake has dropped only a few feet.

The asphalt deposit, in the centre, is at least 175 feet in depth. Borings a few years ago carried a drill to that depth before the motion of the asphalt forced the tubing so far from the perpendicular as to make further efforts useless.

Trinidad asphalt is absolutely uniform, no matter from what depth of the lake it is taken, the most exacting tests have shown. Apparently in this deposit there is sufficient asphalt to take care for all the needs of mankind for centuries to come.

The asphalt is mined by natives, who dig out great lumps of the material with mattocks, or broad edged picks. Other natives lift the lumps to their heads, and carry them to cars on the narrow gauge railroad. A train consists of several skips bearing buckets of about 500 pounds capacity each. Although laid without ballast, the track can be left in position for several weeks, so solid is the asphalt.

An endless cable system draws the cars to the edge of the lake where they are carried either to the waiting steamer at the dock at Brighton or to the asphalt refinery, located on a hill close by the lake.

The peculiar property of Trinidad Asphalt, and the one that makes it the most durable and valuable bituminous material for a multitude of uses, is the presence of mineral matter in colloidal suspension.

The presence in Trinidad Asphalt of a small percentage of mineral matter which could not be eliminated even by the most careful filtering, was noted for many years before the development of the ultra-miscroscope. A study of bitumen extracted from Trinidad Lake in recent years has shown that this mineral matter is colloidal clay with which the oil apparently has become emulsified as it rises to the surface, probably due to the action of the natural gas which accompanies it at very high pressure.

These infinitesimal particles of clay absorb the bitumen, creating a surface energy far in excess of any type of mineral filler added to a bitumen in the usual way and making it the most durable paving material known. The colloidal particles, scientists have estimated, are .000,039,37 inches in diameter, or even smaller, and under the ultra microscope, in a solution of Trinidad and benzol, appear like thousands of tiny insects in constant motion.

### Bermudez Asphalt.

The Bermudez asphalt lake is located thirty miles from the coast of Venezuela. Around this deposit, which covers a much greater area, but is considerably shallower than that of Trinidad, stretches the same luxuriant tropical vegetation. The asphalt deposit, apparently the overflow from a number of asphalt springs, is located in a savannah, between the edge of an expansive swamp and the foothills. It has a width of about a mile and a half from north to south, and a mile from east to west, covering roughly 1000 acres.

There is little similarity between the Trinidad and Bermudez lakes. At Bermudez lake there is no broad expanse of asphalt, almost the entire surface of the deposit being covered with sparse vegetation, grass and shrubs and occasionally groves of towering palms. At certain points the soft pitch is oozing to the surface and at these points gas is given off in considerable quantities. The new asphalt also is much softer than that at Trinidad.

The digging of asphalt at Bermudez lake presents a much more difficult problem, since the asphalt suited for highway building lies a few feet below the upper crust of muck and earth, rotting vegetation and debris from numerous fires. Then, too, the major portion of the lake is traversed with deep crevices, containing rain water and in the rainy seasons, almost all the surface is flooded.

Asphalt is dug from the lake in the same manner as at Trinidad, and is transported by rail several miles through a dense forest to the bank of the Guanoco river, where it is loaded into steamers and shipped to all parts of the world.

### No Mineral Content.

Bermudez Asphalt is differentiated completely from that found in the Trinidad lake by the absence of emulsified water and mineral matter. It is purer and softer, but it contains a high percentage of sulphur.

Crude Trinidad asphalt contains approximately 39% of bitumen, 32% of mineral and other matter and 29% of water. Bermudez crude varies as to its water contents averaging about 25%, 1 to 3% of mineral water and 68 to 72% of bitumens.

Both Trinidad and Bermudez asphalt run together in the hold of the ship during the voyage to this country, or to any other part of the world to which it may be shipped and it is necessary for workmen to pick the material from the hold.

The refining of native asphalts is comparatively simple, consisting of placing a supply of the crude material in large rectangular tanks holding a hundred tons or more, and heating it by means of gangs of pipe carrying steam at a pressure of 125 pounds and of about 325° F. This melts the asphalt and drives off the water. The asphalt is agitated by passing live steam through the material while it is heating. After this process has been completed, the asphalt is run off into barrels and the refined asphalt of commerce is ready for shipment in this country.

The modern asphalt pavement was originated in 1870 by E. J. De Smedt, a Belgian chemist, who sought to obtain a mixture that would approximate the rock asphalt of Europe with which satisfactory highways had been built for some years. He used a combination of sand, powdered lime stone and Trinidad asphalt, softened with a residue from a distillation of petroleum. During the next five years pavements of this nature were laid in New York City, and in 1875-76 the commission of the District of Washington authorized the use of a Trinidad mixture on 54,000 square yards of streets.

Since that time the use of native lake asphalts has spread throughout not only the United States and Canada, but in Great Britain, on the continent of Europe and in Asia.

Many Trinidad pavements more than thirty years old still are in service in cities and are bearing heavy motor traffic successfully. The smoothness, resilience and dustlessness of asphalt highways makes it attractive to motorists, while the durability of such surfaces insures full value for every dollar expended by the taxpayers.

While the first great use for asphalt was as a paving and road building material, the vast possibilities of the material as a waterproofing and weather resisting material soon were realized. To-day there is hardly an industry in which asphalt cannot or does not play a part.

Could Raleigh return to this earth and view the tremendous uses developed for the material with which he caulked his storm racked vessels centuries ago, he would be as much surprised as would Caesar could that vaunted campaigner view modern devices for warfare.

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## Guild Movement in the Building Industry of Britain is Gaining Headway

Interesting details of the progress of guild socialism in the building trade in England were given at the conference of the national building guild at Manchester recently. At present there are 115 guild committees in operation throughout Great Britain. The movement is gaining particular headway in Scotland and Wales.

Houses now completed are valued at thirty thousand pounds sterling, and in every case the work has earned the compliments of the Ministry of Health and the local authorities. Guild tenders had always been below estimates furnished by private builders.

Recently the guilds have been hampered by lack of finances. It is now proposed to raise a loan of one hundred and fifty pounds, to finance future building operations. They were aiming, said Mr. H. Frankland, to capture control of the whole building industry of the country, and would in future refuse no contract, however large, or however remote its situation might be.

Mr. Hobson, the guild secretary, declared the loan now being raised was a mere flea-bite to what was contemplated. "We must sooner or latter have as many millions," he said. "If we are going to take control of the building industry, in Britain, we will require a turn-over of two hundred and fifty million pounds a year. That is what we're aiming at." Mr. Hobson prophesied the time was coming when the guilds and the trade unions would have to create their own credit, and if necessary, also their own currency.

# Waste of All Forms Prevalent in the Building Industry

## After Thorough Investigation of the Situation in the Construction Business the American Engineering Council, Through its Committee on Elimination of Waste in Industry, Concludes that There is Need for Thorough Readjustment of Building Methods—A Recital of Wasteful Practices in the Present System

Half a billion dollars a year in wages is being lost in the building industry through unemployment, it is asserted in a report made public by the Committee on Elimination of Waste in Industry of the American Engineering Council, appointed by Herbert Hoover. Lack of work is declared to be the outstanding fact in this industry, whose critical condition following the war is attributed primarily to the high costs of construction.

Waste, it is said, is causing huge losses in building which, including all trades and common labour incidental to it, ranks second among the industries and contributes to the wealth of the nation more than $3,000, 000,000 yearly. Yearly averages for the past six years show that 32 per cent of the activities of the industry, which employ some 3,000,000 mechanics and laborers in a single year, are devoted to residential buildings, "Miscellaneous" covering the rest.

### Chief Sources of Waste.

The chief sources of waste in the building industry are, according to the report, irregular employment, inefficient management, and wasteful labor regulations. Customs or conditions prevailing throughout the industry, and poorly designed equipment are given as secondary causes.

The annual economic loss due to accidents is estimated as high as $120,000,000. Application of safety methods, it is stated, would save to the industry 12, 000,000 days a year.

Loss through duplication of estimates and designs, and duplication in bidding, is said to run into the millions. An acute national shortage of housing exists, the committee says, with costs prohibitive to householder and banker. Improvement in production is noted as a result in part, of weeding out "war's misfits." Many union rules are condemned as "absolutely wrong." Both employers and employees are blamed for restriction of output.

The committee's investigation covered the entire country, special attention, the report says, being paid to representative cities such as New York, Boston, Philadelphia, Baltimore, Chicago, Cleveland, Atlanta and San Francisco.

The inquiry into the building industry was made as a part of a national assay of waste conducted by the committee, of which J. Parke Channing of New York is chairman and L. W. Wallace of Washington vice-chairman. This assay originated with Herbert Hoover, who recently retired from presidency of the American Engineering Council and embraced six leading industries. The building investigation was in charge of Sanford E. Thompson of Boston who directed a large force of field workers.

### Building Workman Busy Two-thirds of his Time.

"The building trade workman," asserts the report, "is busy on the average about 190 days in the year, or two-thirds of his time. A few contractors, individually or associated, are attacking this problem with effective results. The public also must be educated to the need of sensible distribution through the year of its construction demands and requirements. Idleness, however, is due entirely to seasonal demands; strikes and lockouts are appreciable causes.

"Haphazard management in planning and controlling work and lack of standards, which often double the labour cost, characterize most construction undertakings. Here, again, a few builders, recognizing the waste in money and man power, are adopting methods that approach modern factory management.

"Union regulations in the past have produced enormous losses through direct or indirect restriction of output. Workmen and contractors, however, are beginning to appreciate that reduced output reacts in tremendous fashion upon themselves.

"In some construction trades, accidents involve losses up to ten per cent. of the labour cost in addition to the human loss of lives and energy. The average loss, computed from insurance statistics, is about two and one-half per cent. of labour cost. Here also certain contractors have found it possible to cut their accidents in half through special efforts,

### Greater Co-operation is Essential.

"Greater co-operation between the workmen and the employers is an absolute essential. This co-operation must be attained before we can approach the elimination of labour difficulties. Such co-operation, however, is impossible without the removal of causes of friction and the working out of plans to that end.

"A striking fact about the building industry is that inasmuch as small buildings require so little capital or credit, and apparently so little technical ability, the field is full of small contractors, many of whom operate for a few years and then fail. In Cleveland, O., for example, out of 4,000 contractors perhaps not more than 400 are needed. From these small firms the range runs up to the highly capitalized company with yearly business in the millions, employing thousands of workers and having a trained technical organization."

The total shortage of housing in 1921, it is found, amounts to 53 per cent. of the total square footage (called the real measure of value) constructed in 1915.

"To this perecntage must be added," the report continues, "if we consider the footage constructed in 1915 as equal to the requirements of that year, seven and one-half per cent. which represents the increment required to cover the increase in population.

"The need for building is most evident. The costs are so high, however, that the householder cannot afford to buy, nor can the banker loan money because of the danger of loss through the inevitable fall of prices.

### The Reason for Tight Money.

"The high cost of labour and materials in 1920 and 1921 prohibited bankers from loaning money on ordinary building and dwelling house construction. They reasoned, and correctly, that the price of materials and labour would drop so that buildings erected at a later date would cost less, thus causing a fall in the selling prices. Added to this have been the income tax conditions, so that the funds which were at one time available for mortgages have been forced into tax-exempt securities. Notwithstanding, therefore, the shortage of housing and the need for new construction, the actual work going on has fallen to a remarkably small figure and this in turn has been reflected in unemployment. In certain cases advantage has been taken of the conditions.

"Much has been said in 1921 of the inefficiency of building labour during the last few years. However, except where effective management with well-defined standards have been in operation, there have been similar complaints throughout the country in all industries. This inefficiency has been due to the abnormal conditions.

"The war necessitated calling into the ranks of unskilled workers and into the foreman class men unfitted by character or training for their jobs. The demand continued to exceed the supply, resulting in bidding for men and boosting of wages.

"Because of the unprecedented demand, organized labor forced concessions not only as regards increases in wages, which were usually justified by the increased cost of living, but also as regards working rules which led in many cases to curtailment of production. The speed needed on government work to win the war, with the lessened care for cost engendered by the cost-plus contract, resulted in less effective operation. The men naturally became accustomed to this inefficient method of working and it furnished in one sense a standard for future efforts.

"With the depression in business and the lessened demand for all kinds of labour, the average production in all industries is again approaching normal. Certain contractors are again basing estimates on the assumption that labour is normally efficient. The improvement is in part due to the weeding out of misfits in both labor and management."

### Waste Through Irregular Employment.

Analyzing the causes of building waste, the report says irregular employment is due to seasonal fluctuations, bad weather, strikes and lockouts:

Inefficient managament is blamed on failure to furnish continuity of employment; failure to plan work in sufficient detail; lack of proper schedules to allow proper co-ordination of scheduling, purchasing, delivery, with job requirements; lack of standard and adequate cost methods as a means of checking production; high labor turnover; failure to use proper amount or type of equipment; general failure to develope and use a greater amount of mechanical equipment; and waste of material through careless handling and improper plant operations.

Wasteful labor regulations, according to the report, consist of requiring skilled men to do work that could be performed by unskilled, restricting individual incentive through requiring uniform wages, limiting the number of apprentices, excessive reduction of working hours, restricting output by prohibiting the use of labor saving devices, and jurisdictional regulations.

Additional sources of waste are failure of architects to furnish check plans and specifications, duplication of labour in estimating and often in design, and accidents which are particularly important in the building industry because of the extra-hazardous nature of the work.

### Large Fluctuations in Volume of Business.

Large fluctuations in the number of men employed by representative contractors, indicating also the great fluctuations in the volume of business carried on, are reported. Assuming that the figures for unemployment due to all the causes in the building trades in Massachusetts are representative of the entire country, and if one-half of this unemployment could have been eliminated, the value to the building industry or its wealth to the country would haye been increased as follows. 1915, $106,000,000; 1916, $91,000,000; 1917, $113,000,000; 1918, $85,000,000; 1919, $141,000,000; 1920, $192,000,000..

Representative average conditions in the building trades of Philadelphia and vicinity reveal lost or wasted time as high as 44 per cent among iron workers, 37 per cent. among roofers and 29 per cent. among steam fitters, plasterers helpers and stone cutters, 40 per cent. among roofers and 29 per cent. amonk painters and paper hangers. This percentage is based on the relation of the average days worked per year to the unmber of effective days possible.

The days at work average 189 per year for the various trades in Philadelphia. The average of estimates reported by contractors is 210 working days a year. Over half of the lost time, it is estimated, is due to bad weather and the balance chiefly in waiting for or looking for work.

### Turnover Losses.

An extreme example of labor turnover in Philadelphia is the case of a man who in the course of five and one-half years worked for 76 different contractors and was hired 108 times. The report says the enormous turnover causes losses to both employers and men, adding:

"Contractors have given the effect of labor turnover little consideration. In construction work this is particularly hard to determine, especially as the actual percentage of turnover constantly varies as the building progresses and the number of men is increased and then diminished. Men quit because of the type of work they are to perform, risk involved, unfair treatment by foreman, and so on. They are discharged because of lack of work, incompetence, laziness, causing trouble, or because better men are available.

"Although efforts toward reducing seasonal unemployment have been local and often spasmodical, recent developments and conferences have shown the possibilities of vast improvement. The means of bringing about a reduction of seasonal unemployment may be outlined as follows:

"Allowance of a small margin of profit for both labor and capital during winter months, development of methods of conducting the work in cold weather, arrangement of work to provide indoor operations in cold and stormy weather, organization of a clearing house for co-ordination of activities, increasing the usefulness of employment bureaus, and educating the public.

### All-Year-Round Operations.

"Contractors must prove to the public that they can carry on operations during the winter period as economically and substantially as during other periods of the year. To do this, contractors, labor, transportation, and material men in a locality must all get together and, after joint study of the situation, agree to reduce profits and wages an amount that will offset the increased cost of carrying on work in winter months.

"The education of the public is vital to a sensible distribution of work throughout the year. This applies equally to industrial, public, and residential construction and to household repairs and maintenance. Instead of crowding our main construction work into seven or eight months, all that can be deferred from the busy to the more idle season should be scheduled. Owners making interior repairs or slight additions should be encouraged to have this work done in the off-peak season. Old buildings to be demolished to make room for new ones should be torn down in cold weather in advance of the new construction instead of waiting, as it is often done, until the new building ought to be under way.

"Real estate dealers lease apartments usually in October and do all the redecorating work and repairing at this time. An architect in New York City has stated that some 25,000 painters and paperhangers are needed during this brief period, while normally only 5,000 men are required.

"With a central bureau, under the auspices of the employers, the workmen, and the public, these and many other things would be studied with effective results."

### The Strike is an Economic Waste.

The strike is one of the greatest economic wastes to be found in the building industry, the report declares. "The waste to the men engaged, the contractor, and the public is hard to estimate. The major causes of strikes are occasioned by demand for increase in wages, recognition of the union, decrease in working hours, and by jurisdictional disputes.

"Incidental to these causes and often aggravating them are the working conditions, while in almost every case the prime factor is the lack of understanding and failure of the employers and the workers to get together.

"The number of strikes and lockouts occuring in the building trades increased from 302 in 1914 to 452 in 1919, an increase of 50 per cent. This increase is accounted for in part by the greater demand for labor in 1919, which inevitably makes the requirements of workmen more exacting and arbitrary. Of the 1919 figure, 452, only 18 or four per cent, are listed as lockouts, so that the waste due to lock-out is relatively small."

If the Massachusetts rate of 138,519 working days lost in 1920 is applied to the entire industry a waste of some 3,000,000 days per year is found. The report continues:

"If the greatest cause, the demand for an increase in wages, could be eliminated, strikes as a factor of waste would shrink into insignificance. The remedy that suggests itself is co-operation. Management and labor must forget the sore spots of past conflicts and through whole-hearted co-operation fix by proper studies a minimum wage to correspond with a standard amount of production, with additional compensation for additional output. This would furnish an incentive to men and would give recognition to deserving mechanics.

### Elimination of the Flat Rate.

"Unions must co-operate to the extent of eliminating the flat rate for all mechanics of a trade, and to the extent of modifying the restriction that forbids mechanics to accept piece work. With definite standards fixed and with the co-operation of both parties fair incentives can be introduced.

"The most encouraging sign in the elimination of the above causes is found in what is known as the 'Philadelphia Plan' put forth by the labor element of that city."

This contemplates the organization into a single body through associations, groups or committees, of each employing branch of the building industry in number at least equal to the nineteen represented in the Council of the Associated Building Trades. A heading up committee, composed of an equal number of representatives from the groups of employer and employed would constitute the tribunal or council of the building industry in Philadelphia. The plan purposes the establishment of a central bureau through which voluntarily all construction programs in the territory should be cleared, including national, state, municipal, and private work.

The old methods still exist in many quarters but are passing, the report says, adding:

"They must not be replaced by a 'go-easy' policy which takes all the stamina and character and individuality out of a man, but by well defined methods, such as definit records of accomplishment, scales of wages based upon quality and quantity of work done, or bonuses for coming within the required standards of quality and production. All of these devices, however, are worthless without determination of standards, knowledge of a proper day's work and control of the work and materials as above described."

### Not Enough Mechanical Equipment.

General failure of the building industry as a whole to develope and use a greater amount of mechanical equipment is an established fact, the report says. Greater strides have been made in almost every other industry in the application of mechanical means, it is said. Union objection to labor-saving devices is wrong in principal, it is declared, and will be relegated to the past like the restriction of output.

"With thorough co-operation of unions with employers and the development of the old guild spirit, which tends to give a man pride in the quantity and quality of his work, there is the possibility of increasing production and, by these means, of maintaining high wages yet with a resultant lowering of costs." says the report. "Lower labour costs mean more building and more continuous employment for the worker.

"Many union rules are absolutely wrong and uneconomical. Many unions have exceeded the limits of fairness, and partly because of the leaders' lack of appreciation of the fundamental need for high production, have formulated by-laws, and, in individual cases, have formulated demands that have been a tremendous factor, directly or indirectly, in the restriction of output. This has resulted in increase in cost and reduction in the demand for building. It represents, in fact one of the great sources of waste in the building industry. This policy has reacted, resulting in widespread opposition to unions. In fact, some of the most successful building contractors employ non-union labor because of their opposition to unjust union rules and requirements.

"It must be recognized that the unions are by no means alone in their restriction of output. The contractors and builders and supply dealers affect the situation to as great a degree indirectly by maintenance of high prices, collusion in bidding, and unfair practices. Collusion between unions and employers also has raised prices unduly.

**No Incentive for Large Output.**

"One of the greatest fundamental causes for low output is the fact that all members of unions in the same trade are paid the same wage. There is no incentive. As a result of records made by the authors on actual construction work, it was found that in the building trades on every job there there are usually a few men who do one-third more work than the average man on this same job. These men also do better work. Is it fair to these good men for them to receive the same wage as the others?

"Restriction of apprentices in many cases is extreme and unfair. Overtime and travel rules, also tend to increase building costs unduly.

"Many unions at the present time have in their by-laws no requirements for restricting output, contrary to good principals. A potent source of labor waste is the jurisdictional practice which distributes certain types of work to different trades, frequently without regard to expense."

Despite the restrictive action of many of the union regulations, says the report, there is growing evidence of willingness to co-operate. Philadelphia and San Francisco are cited as cities in which co-operaton is evidenced. In Cleveland co-operation in tile setting, it is said was hindered by employers. Co-operation in the needle trade of Montreal is pointed to as an example for the building industry.

One of the principal aims of the trade unions, the report states, should be to make their services valuable to the employer by developing and training the men in their organization and establishing a high standard, by assisting in the development of standardization of time, method and material.

**Losses Through Accidents.**

Enormous losses are suffered through accidents, the $30,000,000 paid yearly to insurance companies for compensation and liability insurance by no means representing the total lost, according to the report which adds:

the opinion of one of the best authorities in the country the actual cost of insurance represents not more than 25 per cent. of the total economic loss, which brings the total cost due to accidents in the vicinity of $120,000,000 per year, a staggering total."

In Massachusetts during one year accidents caused a loss of time of 485,486 ways. In New York State, where four times as many workers are employed in the factories as are employed in building and construction work, there are more fatalities due to accidents in building than in factories during a four year period.

Accidents, it is stated, are largely caused by carelessness of the workmen, or lack of ordinary safeguards. Conditions which would not be tolerated in a factory for 24 hours are found on every job, it is asserted.

Great savings are possible, says the report. "An official of a large insurance company believes that by proper safety measures the waste due to accidents can be reduced to 75 per cent. in from two to five years of honest effort, and that construction labor cost can be cut three per cent. by these measures. Another official estimates, from actual accomplishment in safety measures, that a total of more than 12,000,000 days a year could be saved the industry by the application of safety methods."

**Delays Caused by Architects.**

Architects, the report says, frequently cause expensive delays and occasionally complete shutdowns by failure to deliver detail plans at the proper time. The waste of time and energy and money through duplication of estimates and of designs, it is declared, runs into millions every year. An equal, if not greater, source of waste is said to be the duplication in figuring quantity by all bidders.

The report, which states that both government and state records were found sadly at fault in quantity, kind, and accuracy of data, concludes.

"The most encouraging feature in the building industry to-day is the action of a few of the builders and a few groups of building trade workmen in making intensive studies of the causes and remedies for irregular employment and haphazard conditions of work. Along with this is the growing appreciation on the part of both labour and management that to build more buildings and maintain high wages it is necessary to attain greater and greater productive capacity per man.

"They see as proof of these facts that the 1921 depression was caused and extended by too high costs of all products, and that business, either in manufacturing or in building industries, is improving only as the costs of material and the cost of labor are reducing. All are recognizing, in fact, that no progress can be made with paying greater and greater attention to the elimination of waste.

"Never in the history of our country was it so important that certain fundamental principals of economics—principals which are not mere theories, but are based positively on facts—should be accepted and established as a working program. These principles will throw overboard the fallacy that restricting production can make work go further, and will supplant this with the knowledge to get one must give, that to receive the equivalent must be given in money or in time or in effort, and that increased returns can only be attained through increased production."

# A Study in Millwork Costs

Millwork costs was one of the main topics for discussion at the meeting of the Southwestern Ontario Retail Lumber Dealers' Association held recently at Chatham, Ontario. A committee, consisting of M. R. Bogart, Chatham, L. H. Richards, Sarnia, John T. Wallace, London, and B. F. Clarke, Glencoe, had been appointed to consider millwork costs and the report they brought in is as follows:

In the first place we have only considered such items as generally affect all members of the Association, such as inside and outside door and window frames, feeling that with these essential items on a proper basis, the better grades of mill work such as stairs, panelling, etc., will naturally adjust themselves.

Each member of the committee gave the subject considerable attention and worked out the costs in each factory individually and on meeting together were surprised at the similarity of their results and, therefore, feel that the figures shown represent the actual facts. Facts, with which we as mill men are sufficiently familiar.

All estimates on outside frames are based on using white pine throughout and all frames are figured assembled or built up. The costs arrived at and agreed upon are as appended, and we are indebted to Mr. Richards for printing them.

The question of trim has not been considered as it is simply a matter of computing casings, etc., per lineal foot from any of the published wholesale lists, and which costs, plus freight, should represent our own productive costs on these items. Your Committee also found in this connection that nearly every mill had a different system of supplying such trim so that no set cost could be shown.

Please bear in mind that the prices shown are costs and do not include any profit whatever. This must be added and can only be determined by each individual member.

Your Committee were a unit in expressing the opinion that, under present conditions and prices, our factories are being run either at a loss or on altogether too small a margin of profiit, considering the investment involved, being merely an adjunct to our yards, and recommend that some effort be made to place the factory upon a more profitable footing so that it can stand independent of the yard as regards profits.

Under existing conditions the yard man who has no mill, and is buying his mill work from a nearby factory has a more remunerative investment than the man who has the drag of a factory upon his hands, a condition which, in our opinion, should be remedied.

### Factory Costs Report.

The figures submitted by the Mill Work Cost Committee were as follows:-

Window Frames—

| | |
|---|---|
| For either frame or brick veneer wall up to glass width of 30 in., 19 ft. B.M. white pine in jambs, heads, etc., at 10c | $1.90 |
| Mouldings— | |
| 16 ft. blind stop, wt. pine, 1½ | .24 |
| 16 ft. parting stop, wt. pine, 1½ | .24 |
| 16 ft. O.G. 1¾ stop, wt. pine, 1½ | .24 |
| 16 ft. brick mldg., wt. pine, 3 | .48 |
| | $3.10 |
| 15 per cent. lumber waste | .46 |
| 4 pulleys | .40 |
| Machine work and assembling | 1.25 |
| Nails and screws | .12 |
| Cambers and braces | .50 |
| 50 per cent. overhead cost on labor | .63 |
| Total cost | $6.46 |

The price of $100.00 per M. on wt. pine lumber in jambs, etc., has to take care of difference in sizes of jambs, etc.

| | |
|---|---|
| Window frame for solid brick wall, add | .50 |
| For same window frame for glass width over 30 in. and without transom bar, add | 2.25 |
| Double or mullion frames | Double above prices |
| Triple frames | Three times above prices |

Casement Window Frames—

| | |
|---|---|
| Cost based same as above, say for glass size 24 in. x 30 in. 1 lt. | $5.90 |

Sash and Doors—

Cost on these not gone into, owing to the complete information in Sash and Door Association Catalogues, showing actual cost to us.

Outside Door Frame—

| | |
|---|---|
| 24 ft. B.M. wt. pine in jambs, at 10c | 2.40 |
| 18 ft. brick mldg., at 3c | .54 |
| Cambers and braces | .50 |
| Nails, etc. | .10 |
| 15 per cent. waste on lumber | .44 |
| Labor, machine and nailing up | 1.25 |
| 50 per cent. overhead on labor | .65 |
| Total cost | $5.88 |
| If 2 in. oak sill, add | 1.00 |

Inside Door Frame K.D. with Stops Supplied--

| | |
|---|---|
| 18 ft. R 1 x 6 clear Y. pine, 9 ft. at 10c | $ .90 |
| 18 ft. R stop 1¾ pine, at 2c | .36 |
| | $1.26 |
| 15 per cent. waste on lumber | .30 |
| Labor | .40 |
| 50 per cent. overhead on labor cost | .20 |
| | $2.16 |
| For arch jamb, add | .50 |
| For 2 in. rabbetted jambs, same basis | 2.40 |
| For 2 in. arch jambs, add | .75 |

Cellar Window Frames—

| | |
|---|---|
| 12 ft. B.M. 2 x 8, 16 ft. B.M. wt. pine, at 10c | $1.60 |
| 4 ft. B.M. oak strip | .15 |
| 15 per cent. waste on lumber | .26 |
| Nails | .10 |
| Actual labor paid | .75 |
| 50 per cent. overhead on labor cost | .38 |
| | $3.24 |
| For coal chute frame with oak sill, add | 1.00 |

# The First Reinforced Concrete Bridge in Winnipeg

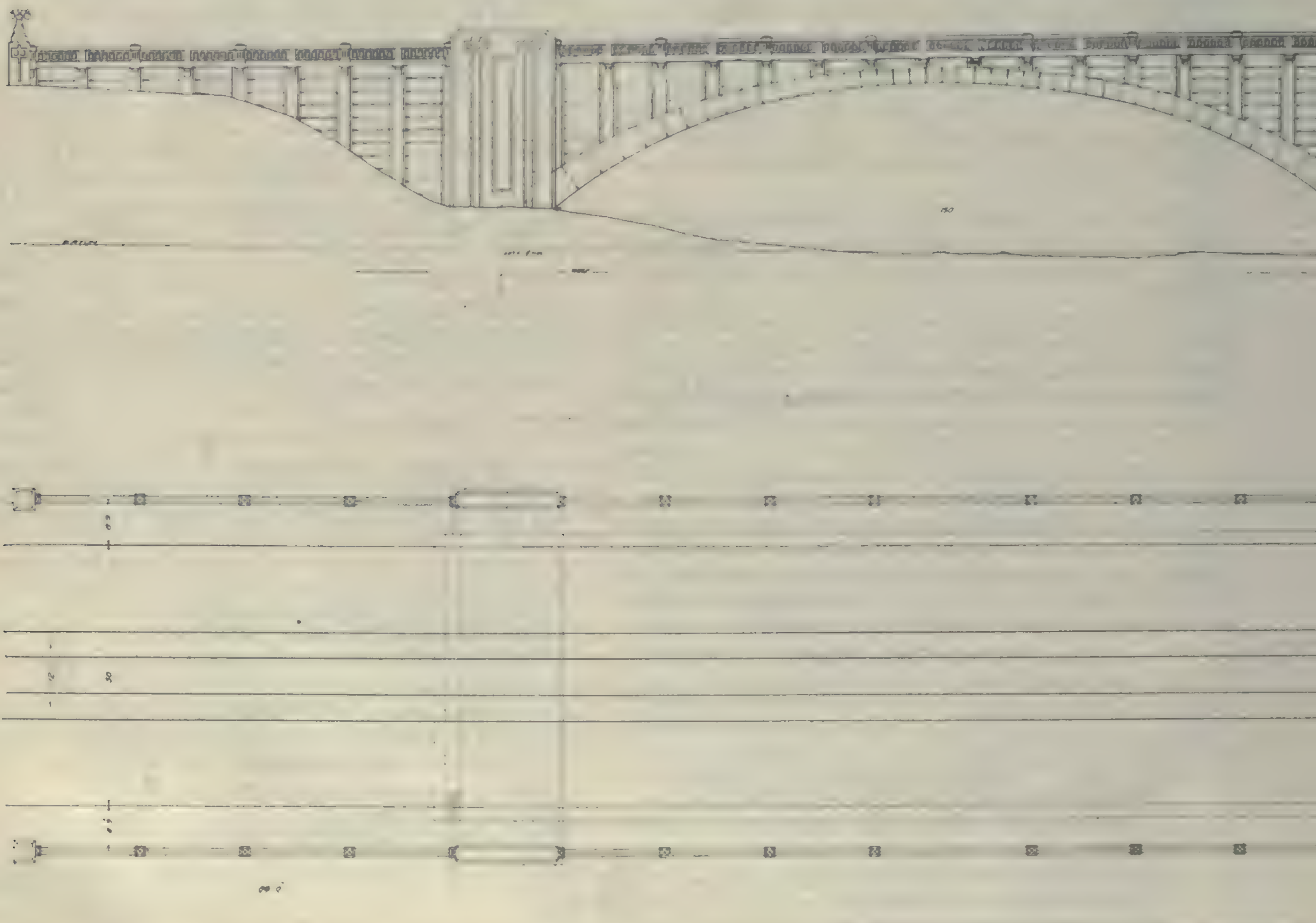
## Construction Proceeding on 523-ft., Two-Arch Structure Over the Assiniboine River—One Half of the Bridge Being Built at a Time to Avoid Interruption of Traffic

The city of Winnipeg, Man., is now building its first reinforced concrete bridge over the Assiniboine river, at Maryland Street. Both the Red river and the Assiniboine run through the city and previously both rivers were considered navigable; consequently all the bridges over these rivers were required to be of the opening type, the centre of the main span having to lift or swing to permit the passage of river traffic. Owing to the shallow depth of the water in parts of the Assiniboine the traffic consists of little more than a few small row boats and gasoline launches, and as there seems little possibility of sufficient development to necessitate provision being made for larger traffic, the river has recently been declared as non-navigable, which now permits the construction of fixed span bridges.

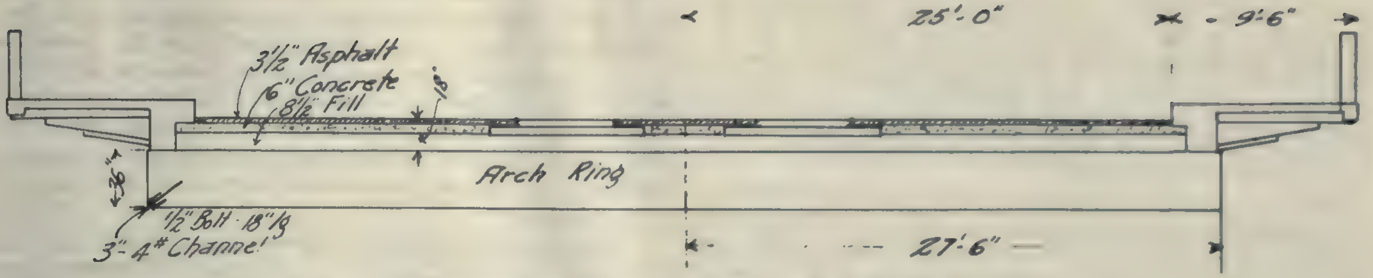
After due consideration of designs for various types of steel and reinforced concrete bridges, the city council decided to adopt the reinforced concrete design shown herewith, the plans of which were prepared in the city engineer's department under the direction of W. P. Brereton, city engineer. Mr. Brereton's assistants directly associated with the work are: W. Aldridge, assistant city engineer; A. H. Cotman, chief draughtsman, and G. F. Green, consulting engineer.

The length of the bridge is 523 feet over the parapet piers of wing walls. The arches are of equal span, each being 150 feet clear.

The width of the bridge, centre to centre of parapets is 67 feet, 6 inches, the roadway between curbs being 50 feet. The sidewalks are cantilevered outside the arches as shown in the section, Fig. 1. The structure is designed to take a double track street



Plan and elevation of Winnipeg's first reinforced



Cross-section of Maryland street bridge, Winnipeg

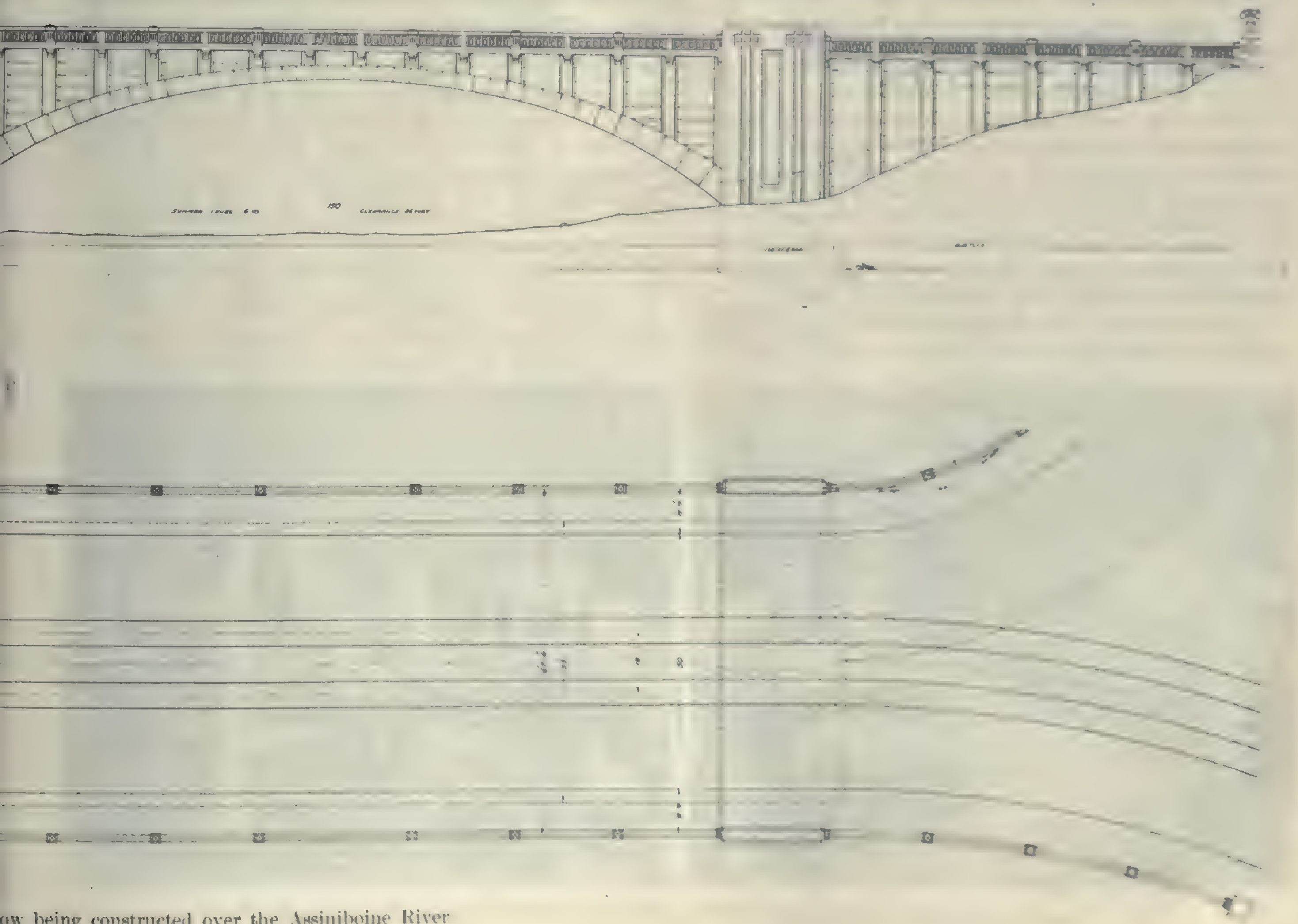
railway with cars weighing 50 tons. In addition 100 pounds per square foot is allowed for road and sidewalk traffic. Temperature stresses were considered for a range of 50 degrees.

Construction work was commenced during the winter and good progress has been made to date. The abutments and centre pier are complete and ready for the arch construction. The false work for the arches is also well under way.

Owing to the recent settlement of several buildings situated on the river banks close to the site of the bridge, through sliding and erosion of the subsoil, which is clay of a very soapy and slippery nature, it was deemed advisable to take no risks with the foundation work. Consequently the abutments and centre pier were taken down to bed rock, and to be sure that no lateral movement would take place, from ice pressure or arch thrust, the rock was excavated several feet in depth, forming a pit into which the concrete was placed. By this means the whole structure will be securely anchored to the rock foundation.

The arches are 3 feet thick at the crown and 6 feet thick at the springing. The extrados are reinforced with 3/4 inch square rods at 24 inch centres at the crown, 3/4 inch rods at 12 inch centres at quarter span, one inch and 3/4 inch, each at 12 inch centres, at the haunches. The intrados are reinforced with 3/4 inch square rods at 12 inch centres throughout. The face of the arch is grooved radially, representing stone voussoirs. The bridge floor slab consists of 6 inches of concrete finished with 3-1/2 inches of asphalt; the concrete is reinforced with 1/2 inch square rods at 12 inch centres.

An unusual feature of the construction lies in the fact that one half of the bridge is to be built first; this is due to the location being such that the west line



ow being constructed over the Assiniboine River of the new structure comes within the line of the old bridge and to the fact that the road traffic is not to be interrupted during the time the new bridge is being built. Consequently, the downstream half of the bridge is to be constructed first and the traffic diverted hereon while the old bridge is renewed and the other half of the new one built.

When completed the new bridge will be pleasing in appearance and an attractive feature of the district it will serve, which is the finest residential portion of Winnipeg. Owing to the rapid development of this district the old steel frame structure had become quite unsafe for present day traffic. The new bridge became a necessity and will undoubtedly add much to the further development of the district.

## BRITISH EXPERTS TO SURVEY RUSSIAN HARBORS.

As a result of a request made to the British Board of Trade by the Soviet Russian Government, two British Engineers are to go to Russia to survey harbors and maintain their safety for navigation. V. Havelock Case, a dock and harbor expert, and D. B. Male, an authority on salvage operations, have been selected for the work. The Soviet Government requested the the assistance of the British Board of Trade, which consulted the London Salvage Co,

# The Daylite Clothing Factory

### A Fine Example of Increased Production and Improved Working Conditions Due to Better Lighting

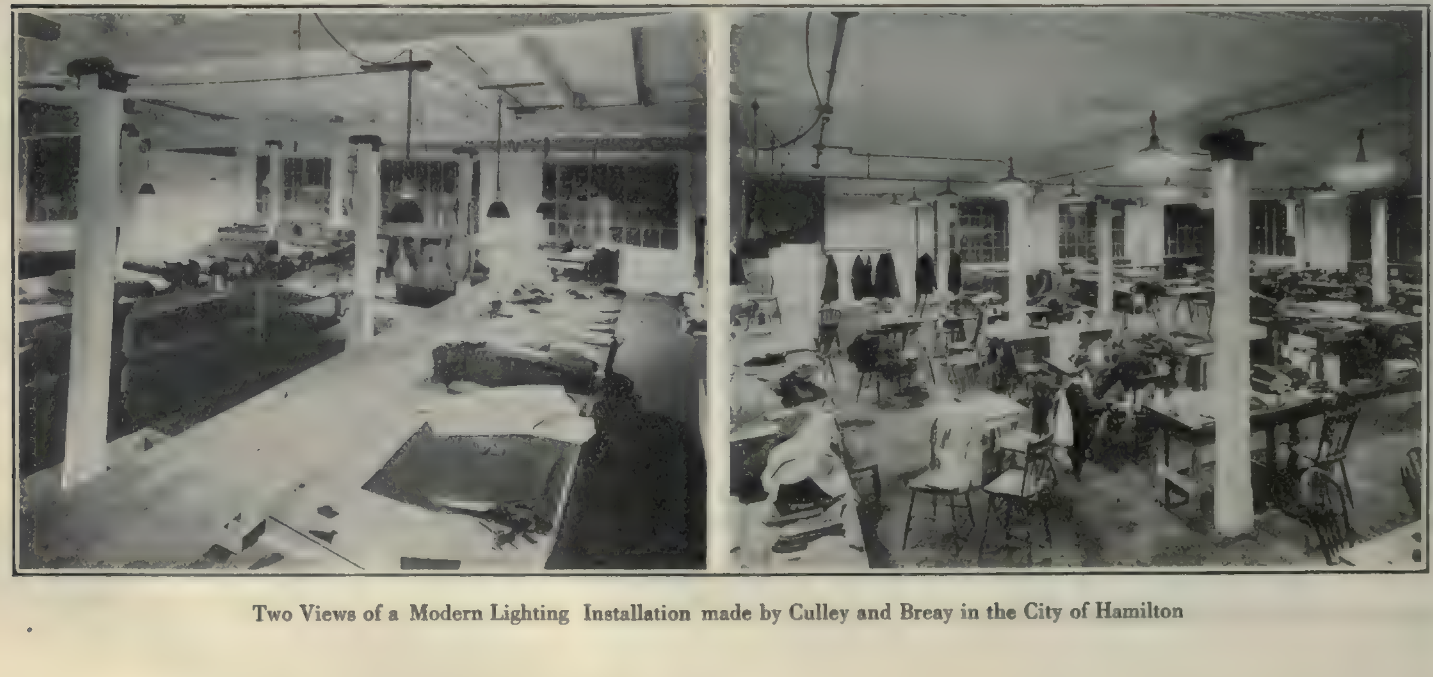
In no other industry has electricity played such an important part to increase production and improve working conditions as in the clothing industry The use of electric pressing irons to replace the old sad iron formerly heated by gas and by coal stove, has been a big advance for the improvement of the working conditions for the presser. The fumes from the gas were very injurious to the health of the presser, and the heat in the summer made this work very undesirable.

In the following illustrations the standard electric tailor's pressing iron has been installed. Each iron outlet is controlled by a Bryant-Perkins surface combination heater control with pilot light, switch and receptacle for attaching the iron. The pilot light is very important to indicate when the current is on or off the iron. The sewing machine tables are all motor driven. The motors are 3 phase 220 volts, 25 cycles, direct connected to the line shaft under the table and mounted on the floor. This eliminates the belts and makes a very compact installation. All motors are controlled by Square "D" enclosed motor starters.

The alternating current motor is very desirable for this work, as it eliminates the fire hazard with the direct current motor. There is no arcing, owing to commutator and brushes not being used with the alternating current motors. There is always a considerable amount of lint and small pieces of cloth around the floor in the clothing factory which makes a serious fire hazard with any arcing or sparking under the table. Each machine table is equipped with two motors, one at each end.

The service for lighting and power in this factory is obtained from two central stations, which gives a continuous service in the case of breakdowns. By the use of a 400 amp., 3 pole unfused, 220 volt, Square "D" enclosed safety switch the service can be transferred to either source instantly. The cutting of cloth in large quantities is readily accomplished by the motor driven knife, as shown in the illustration. This apparatus is a big improvement over the former method of cutting all cloth by hand.

The lighting throughout consists of Benjamin porcelain enamel steel reflectors of the deep cone and R.L.M. types. The deep cone reflectors were used over all cutting tables mounted 6 ft. 0 in. from the top of the table, and 6 ft. 0 in. centres, using 100 watt Mazda C. bowl frosted lamps. The average intensity on the working plane was approximately 5 foot-candles as measured by the portable foot-candle meter. All reflectors are hung with ½ in. wrought iron pipe directly attached to the reflector, with a Benjamin hanger and shock absorber at the ceiling. A screw hook was provided in the ceiling for hanging the reflector. This hook provided a flexible means by which the location of the units could be relocated without a great deal of difficulty. A 4 ft. reinforced flexible cord was provided between the unit and the outlet to add to the flexibility of the system The cord was connected to the outlet by the means of a Bryant K.A. outlet box receptacle and pin plug, which fits in the outlet of the box and is secured with a standard ½ in. lock nut. At each outlet a Bryant ceiling pull switch is provided to control every two units. This method of sectional



Two Views of a Modern Lighting Installation made by Culley and Breay in the City of Hamilton control is very convenient and provided a means of saving current when lights are not required in certain sections of the plant. With the 4 ft. of flexible cord it is possible to move the reflector around the outlet without changing the position of the outlet. If any repairs are necessary the reflector can be disconnected by withdrawing the plug and unhooking the hanger. By using the Bryant receptacles in the outlet boxes no joints are required, all connections being made in the terminals of the reecptacles.

The lighting in the finishing departments consists of R.L.M. reflectors mounted 10 ft. from the floor and 10 ft. centres. Using 150 watt R.L.M. Benjamin reflectors, the average intensity was 5 foot-candles as measured with the portable foot-candle meter.

All of the wiring throughout is installed in exposed conduit pipe, as the building is of mill construction. The building is all painted mill white throughout, which increases the reflection and helps the lighting system. This factory is owned by P. Firth Bros. of Hamilton, Ontario, who operate one of the largest custom tailoring businesses in Canada, with branches in all the important cities.

The complete installation was made by Culley & Breay, one of the leading electrical contracting companies of Hamilton, Ontario. It was built to the design of Mr. V. K. Stalford, who also superintended the work. This factory has been in operation now for nearly one year, and the equipment has proven very satisfactory in every way.

## Mainly Constructional

**East and West—From Coast to Coast**

Warden M. R. Taylor, reeve of Port Dover, Ont., presided recently at the formal opening of the new bascule and trunnion bridge at the above point.

A consignment of paint was recently delivered to Mr. J. P. Gibbons, hardware merchant of Port Colborne, from a Montreal firm by aeroplane.

The nineteenth annual convention of the Universal Craftsmen Council of Engineers will open at the King Edward Hotel on Aug 1 and continue in session for six days.

The recent large fire at the Hamilton waterfront resulted in a total monetary loss of $66,000. The largest loser was the Cummer Ice & Coal Company, who estimate their loss at $59,000.

The city of Winnipeg, under the post-war housing relief fund, will have advanced a total of $1,435,000 for construction of 356 dwellings when the 1921 building season comes to an end November 1.

The Kaministiquia Lumber Co. are erecting 20 frame construction houses at Fort William. This is but a start on a comprehensive housing development scheme which the compropose carrying out.

It is announced the erection of a modern 200-room summer hotel on the site of the old Fraser Hotel, Invererie Heights, Port Stanley, Ont., is planned, which will cost in the neighborhood of $150,000.

Kent County, Ont., announces excellent progress being made on its $600,000 road building program. Roads, of the concrete type, are being laid in six different parts of the county and it is expected these will be completed this year.

The International Joint Commission has arranged for the photographing of the St. Lawrence River route by aviators of the Dominion Air Board. The object of this photographic survey is to determine at what points along the route dams and other works are required.

The revenue from motor vehicle license fees collected by the New Brunswick provincial government so far this year amounts to $250,000, while last year's revenue from this source was $198,000. These figures indicate the tremendous rate of increase in the number of motor vehicles in use throughout the province.

The new firm of Toronto Asphalt Roofing Company, notice of whose incorporation appeared in the Contract Record several weeks ago, have purchased a plant at Mount Dennis, just outside the city, and will manufacture a high-quality asphalt roofing. The head office of the new firm is at King St. E., Toronto, and the officers are: Mr. J.W. Milne, president; Mr. J. J. Kelly, vice-president; Mr. J. Dugdale, treasurer; and Mr. F. P. Turner, secretary.

A new firm, under the name Adanac Motor Syndicate, has been organized at Lachine, P. Q., to manufacture motor trucks. The company has just produced its first sample truck. The address of the new company is 163 St. Joseph Street, and the present organization is composed of Messrs. Gordon A. Elmslie, H. Milton Purnell, B. H. T. McKenzie, B A. Malkin, Robert Connon, A. T. Sutherland and H. Elmslie.

A rumor from Montreal is to the effect that a new company is being formed there to promote the construction of 1,700 workmen's dwellings within the next three years, local labor and supplies to be employed. The houses will all be six-room structures, of solid brick construction, and may be erected singly or in groups at any point throughout the city. The interiors of the houses will be exactly the same, but a choice of six exteriors may be had. A brief outline of the proposed loan scheme under which these houses will be sold follows. Applicant, first of all, must be a lot holder. The lot holder disirous of participating in the project joins a unit of 100 members, 17 of which units are to be formed in Montreal. For 300 weeks, he will pay to the corporation, a minimum of $10 a week, and he also takes up a mortgage on the balance of the price of the house, at the rate of six and a half per cent. Each week one or more houses is alloted to each unit and the member of the unit who has the most money paid in enters into possession. Should a man die after signing his contract of membership without fulfilling his payments, the house at once becomes the property of his wife or heirs.

## Personal

Mr. A. H. Hawkins, of the Topographical section of the survey department of the interior, has been appointed head of the new Soils laboratory established by the Dominion government at the University of Saskatchewan, Saskatoon. He is a graduate in science from McGill University, Montreal, and has a wide and extended experience as Dominion Land surveyor. Mr. Hawkins took an active part in the founding of the Canadian Town Planning Institute and for the last year has been secretary of that organization.

## Trade Incorporations

Archibald Construction Co. Ltd., with head office at Toronto, capital $100,000, will take over the plant of the Canadian Construction Company and carry on the business of road and public works contractors.

Homes Not Houses. Ltd., with head office at Toronto, capital $40,000 to carry on the business of building contractors.

## BUILDERS FAREWELL TO ESTEEMED ASSOCIATE.

At a luncheon of the Winnipeg Builders' Exchange N. W. Warren, late chairman of the Manufacturers' Association and who has for six years been general manager of the Dominion Bridge Company, Winnipeg, was presented with an engraved gold watch by Major Edward Parnell, on behalf of the Winnipeg Builders' Exchange, the Canadian Manufacturers' Association, and the Winnipeg Board of Trade. Mr. Warren is leaving Winnipeg to take the appointment at Montreal as General Manager for Canada, of the same company.

On behalf of the Manufacturers Association and the Builders' Exchange, Messrs. L. R. Barrett and W. H. Carter respectively, spoke in the higest terms of Mr. Warren's business associations with the building industry and of his untiring efforts to promote the interests of the trade and his willingness at all times to do everything possible to assist progress of construction. Both speakers voiced the extreme regret of their members at losing an associate so much esteemed by all branches of the trade as Mr. Warren.

Mayor Parnell, in making the presentation tendered the thanks of Winnipeg to Mr. Warren for his efforts in promoting the interests of the city and further stated that undoubtedly Winnipeg was losing one of its most valuable citizens, one who had been held in high esteem by all who had been associated with him, either as a citizen or business man, socially or industrially.

## SLATE DUST FOR ASPHALT MIXTURES.

The manufacture of filler for road asphalt mixtures is a promising field for slate waste utilization, according to the U. S. Bureau of Mines. At present from 80 to 95 per cent. of the gross production of all slate quarries in the United States is discarded as waste. In the preparation of asphaltic mixtures for surface roads, in addition to the sand and stone aggregates, finely pulverized limestone or portland cement is ordinarily used as a filler. An attempt as been made by the bureau to determine the adaptability of slate flour for such use. The results of its experimental work, while not yet conclusive, indicate that the use of slate flour as a filler in asphalt road surface mixtures would result in improved highways and that a wide use of such filler would afford a profitable outlet for waste slate, with consequent advantage to the slate producing industry. The cost of slate flour is little more than half that of portland cement.

### "Mouthpieces of Commerce Department."

**An official and generous recogntion of business and technical newspapers as essential factors in modern commerce and industry has been given by Secretary Herbert Hoover, of the Commerce Department at Washington.**

**One of the first steps taken by Mr. Hoover, after he was installed as head of this important department was to invite the heads of the leading business and technical newspapers of the United States to meet him in Washington to discuss with them the problems of his department . Sixty-two men accepted the invitation, and at this meeting Mr. Hoover gave evidence of his high appreciation of the value of the business and technical press by saying: "My view of the matter is that we may well consider the trade publications of the country as the mouthpiece of the Department of Commerce—the contact points by which the business world is to know what we are doing and how we are doing it, and also to carry our industry this message of co-operation which it is my hope to place before every manufacturer in every industry in the country."**

**As an outcome of this initial conference a monthly meeting has been arranged and every month since, Mr. Hoover has held conferences with these publishers. He has frankly admitted that the meetings with the heads of business and technical newspapers are of material benefit to him. He needs the close-up view of business and industry which he can get from those men—as he can from no other source.**

**The minister in charge of the Canadian Department of Trade and Commerce might profit by this experience of Mr. Hoover, and summon to his aid the heads of business and technical newspapers in Canada. A conference with these men wuld give him some vitally important information about trade conditions in Canada, which, it is safe to say, he does not possess at the present time.**

Mr. Fred. R. Miller, who has just been appointed by the Ontario Government to succeed the Hon. I. B. Lucas as a member of the Hydro-electric Power Commission of Ontario. Mr. Miller is vice-president of Roger Miller and Sons, general contractors, a firm known throughout Canada for its efficient work and its absolute integrity in business.

## ANCHORING SHIFTING SANDS.

An experiment will be made by the Ontario Provincial Forester to test whether the shifting sand dunes of Prince Edward county can be anchored by the planting of belts of trees in the sand areas. These sand banks under the influence of winds from Lake Ontario, have been moving inland, covering up fertile lands and rendering them useless. Tree planting has stopped shifting sands in France and other countries, and on the prairies belts of trees keep light soils from drifting. It is expected the plan will prove equally successful in this Ontario county, one of the most fertile in the whole province.

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## *Why Money is Difficult to Obtain for Building Purposes*

Writing on the relative merits of various investments, a contemporary recently pointed to the relatively high rate of returns from Government bonds of all kinds to-day as compared with mortgages. In the old days, when Government bonds yielded 3½ and 4%, a mortgage yielded 6 and 6½%. To-day, with Dominion bonds yielding around 6%, mortgage rates have increased very little and certainly not in proportion.

It has often been pointed out in these pages that the difficulty of obtaining mortgage loans is probably one of the biggest obstacles in the way of increased building activities. Quite aside from the possibility that the value of the property against which the mortgage is written may decrease somewhat in value, there is the other consideration that Government bonds, with the security of the Dominion of Canada behind them, or that of one or other of the Provinces, yield almost as great a return, possess the added advantage of an almost certain probability of appreciation in value, and, in addition, the Government bonds represent a much more liquid form of investment.

It should be the case that the Minister of Finance, whether of a city, a province, or of the Dominion, is sufficiently in touch with financial conditions that he will not pay more for his loans than is absolutely necessary. We believe there are signs, however, and the writer feels he is putting it very mildly—that the various government officials who are responsible for the sale of bonds on different occasions, in their desire to make the various issues attractive, have offered more favorable terms than was necessary. This is evident, we think, by the fact that practically every loan that has been put out in recent times has been oversubscribed—some of them two or three times. This eagerness on the part of the general public to subscribe to government securities has been looked upon by government officials, we fear, as a sort of mark of approval—a vote of confidence in the administration. This is, probably, not the explanation. Writing as one of those citizens, the reason for the ready response to subscribe for the various issues is the fact that they were more attractive, security considered, by a long way, than anything else in sight.

The apparent ease with which money has been obtainable from the general public for government purposes is leading—or has already led—to two general resuts: First our governments have spent money too lavishly: second, money has been invested in government bonds that would normally have been invested in mortgages and industries of various sorts In this way the financial departments of our various governments, probably with the very intention of stimulating industry, have, indirectly, been the means of contributing largely to its stagnation.

## *$340,000,000—the Stupendous Loss Inflicted Annually by Unembloyment in Canada*

The American Engineering Council recently issued a report that idle men and machinery are causing an annual loss of nearly a billion dollars a year in the metal trades industry alone. This estimate covers the value of labor only and does not include the value of material that would be utilized if the productivity of labor were increased.

How does this apply to Canada at the moment? Senator Gideon Robertson, Minister of Labor, recently stated that 17 per cent. of all labor in Canada is idle at the present time and mentioned the total figure of labor's numbers as 800,000. This means that 116,000 men are producing nothing. On the supposition that they are worth, on the average, say, 60 cents an hour, the hourly loss to the country is $70,000; the daily loss on an eight-hour basis is $560,000 and the annual loss, counting 300 days, almost $170,000,000.

This does not take into consideration the increase in wealth which results when raw materials are changed into a form where they are valuable for commercial purpose. On the supposition that labor represents only half of the cost of a finished product, we must multiply this total sum by 2, giving $340,000,000, as the annual loss.

Think of this colossal annual waste—enough to build a highway costing $34,000 per mile across Canada —three times.

## *Quebec Contractors Now Merged into One Strong, Representative Organization*

The conference held at the Builders' Exchange, Montreal, on July 27, marks a distinct departure in the history of the contracting industry in the Province of Quebec. The organization at that meeting of the Association of Building Industries for the Province of Quebec looks like the beginning of a movement which will exert a distinct influence on the future of trade in the province, so far as legislation is concerned. Hitherto the duty of watching proposed legislation and taking action thereon has devolved on the Montreal Builders'

Exchange, sometimes entailing heavy cost, and always considerable trouble. Constant vigilance is necessary, and despite careful watching, bills which affect the contracting industry slip through unnoticed.

The organization of the new association will enable representatives of the industry to approach the government with far more authorty than in the past, either by way of suggestions on given subjects or in opposing the government on private proposals which will be detrimental to the trade as a whoe. Deputations which are representative necessarily command more attention than those which are sectional.

It is with a view to securing this unity of purpose that effects are to be made to organize additional exchanges in the province. These will be represented in the new association, which will thus be truly provincial-wide in its scope. The industry is taking advantage of the comparatively dull times to set its house in order, thus preparing for a revival, when many questions relating to labour and working conditions are certan to come up for consideration. Such matters can be best dealt with by an association which is representative of the entire industry.

# Manitoba's $2,000,000 School for the Deaf

### Progress Being Made with the Construction of the First Unit of Large Institution —Group of Buildings Planned

The illustration herewith shows the progress that is being made with the construction of Manitoba's provincial scheme for the training of the deaf. The two buildings illustrated are the first and most important of the group of buildings comprising the scheme. The other buildings are to be erected in the near future and in order according to requirements.

The main building, shown on the right of the illustration, is in the shape of an H, 250 feet by 163 feet, and is to be the vocational school and dormitories. The other bulding, on the left, is 115 feet by 100 feet and is to be the power house and dining hall.

The walls of the buildings are constructed entirely of Manitoba Tyndal stone, a limestone which is very effective in color. Around the windows, doors, and the copings, the stone is cut, and finished bush hammered. The balance of the work is all Scotch masonry, the whole producing a very pleasing effect. The roof is to be variegated purple slate. The basement walls are of concrete. The floor system throughout is of long span combination concrete and tile construction. The outside walls are furred with 3 inch hollow tile, and the partitions throughout are 4 inch and 6 inch tile. The walls of the recreation room and stair halls are of salt glazed brick, and the corridors are red quarry tile. The balance of the floors are cement finish, covered with battleship linoleum.

Messrs. J. D. Atchison & Co., are the architects and Messrs. Carter-Halls-Aldinger Co., Ltd., the contractors.

# Demolition of Large School on New Hotel Site

### One of the Largest Wrecking Operations Carried Out in Montreal to Pave Way for the Erection of the Mount Royal Hotel

Before commencing the construction of the Mount Royal Hotel, Peel Street, Montreal, it was necessary to clear the site of the Protestant High School, which occupied the major part of the area. This involved one of the largest wrecking operations carried out in Montreal for many years. The school was a building of four storeys, of very substantial construction, with an exterior of pressed brick.

The contract was let to W. Lajeunesse & Co., Montreal, who paid $18,000 cash for the concession. Work was commenced on June 27, the contract callng for the complete demolition of the building within 45 working days, with a penalty clause for every day over this term. When it became known that operations were to be commenced, thousands of men applied on the job for work, and during the first few days the representatives of the company were overwhelmed with applications for work, so much so that they had to get in through the windows of the school. About 165 men were taken on, and this number was employed throughout the period.

In order to prevent dust, and also breakages, the bricks, common and plastic, were conveyed from the various floors to the ground by two freight elevators, constructed of 5 x 5 pine lumber, braced together, taken from the building. These elevators were about 50 feet high, operated by steam, and were placed at two ends of the building. The bricks were immediately sold, and were at once loaded on to rigs supplied by the purchasers. This method of conveying and loading proved very expeditious.

The various pieces of lumber were conveyed to the ground by wooden chutes erected at each floor, while the windows and various interior fittings were sent down by manual labour. The lumber, fittings, etc., were loaded on to 28 double rigs, and sent to the extensive yards of the company at 688 Notre Dame Street East, where 28 men were employed in piling the wrecked material. The lavatory fitting were shipped to Regina. In order to prevent unnecessary damage to the material it was necessary to appoint a foreman on each floor.

Manitoba School for the Deaf under construction

# Chatham's Experience with Municipal Asphalt Plant

## Results of First Year's Operation of Hetherington and Berner Type of Paving Outfit—Repair Work Especially Satisfactory—Lower Costs Expected This Year

By C. H. R. Fuller, B. A. Sc., city engineer, Chatham, Ont.

The City of Chatham is situated in South Western Ontario in an exceedingly flat clay country which in the wet seaon was formerly practically impassible. It is said by some of the older residents of the city that, in the olden days, during the wet season no vehicular traffic was possible on the city streets.

It was therefore not remarkable that under the impetus of necessity the city was forced to construct pavements of a permanent nature giving it to-day a remarkably large mileage of paved streets. No one type of known pavement was laid, the majority of which satisfied the needs of the city for many years.

At the beginning of the year 1920, Chatham found itself n the position of having a large mileage of pavements, many over 15 year old, requiring repairs or complete renewal. The former city engineer, Mr. F. P. Adams and the chairman of the Committee of the Department of Public Works, Mr. H. Fitzsimons made an exhaustive study to determine the most economical method of handling the city's paving problem. It was decided to purchase an asphalt paving plant, partly on account of the difficulty in securing competition among contract bidders, partly to salvage pavements in need of reconstruction by use of hot mix asphalt.

The Hetherington and Berner asphalt paving plant installed in the city of Chatham, Ont.

### Descripton of the Plant

The plant purchased was a Hetherington and Berner new style semi-portable, 2 kettle, 4 foot drum dryer, asphalt paving plant. The capacity is 1,000 sq. yards of 2 in. pavement per day. The plant is 33 feet in height from botom of sand pit to centre line of headshaft, 18 feet wide and about 55 feet long. A driveway 15 feet wide with 10 feet headroom passes through the centre of the plant directly under the mixer. for loading facilities. On one side of the driveway are the dryers, feed elevator. exhauster dust collector, etc. On the other side are the asphalt kettles and mixer room. Directly over the driveway is the hot sand elevator. sand bin, weighing box, and mixer. An elevator is supplied also for the lifting of the asphalt cement from the ground to the kettles. Each batch is approximately 9 cu. ft. of mixture. The power used to drive the plant is Hydro-electric using a 40 horse power motor with belt, enclosed in a separate motor room alongside the plant. The roof and sides of the plant are of corrugated ron over wood sheathing. The steel work, that is, I beams, channels, angles, etc., were suplied and erected by the Canadian Des Moines Steel Co. of Chatham. The erection of the plant was carried on under the supervision of Hetherington and Berner.

The asphalt bucket is supported by a set of scales, which weighs the tare of each charge, ensuring the correct net weight, the bucket carrage being supported on a trackway. The aphalt cement is melted in the kettles which are spanned by the overhead trackway so that the asphalt may be readily dipped into the bucket by the attendant standing on the mixer room floor.

The total cost of the plant including the erection was approximately $20,000.

### Operation of the Plant

The labor used n operating the plant is as follows:—3 men feeding conveyor, 1 fireman, 1 man tending asphalt kettles, 1 mixer man discharging finished material, who acts as plant foreman, 1 watchman and 1 plant nspector. The plant inspector saw that all measurements and proportioning of the mixtures was correct, checked up the period of mixing, saw that all batches left the plant at the proper temperature, made grading tests of the mineral aggregate and made up laboratory samples of the finished mixture and forwarded these to the laboratory for testing three or four times per day

Laboratory testing was carried on by Clarence A. Proctor, Superintendent of Asphalt Contruction, City of Detroit, who was retained by the City of Chatham for this purpose.

The average temperature of each load leaving the plant was 325 deg. F. During the season 1920, this plant turned out 30,327 square yards of pavement at an average thickness of 2 in. which was a fair yardage considering the lateness of the commencement of operations. The cost of this work is given further on in this article.

### Repair Work

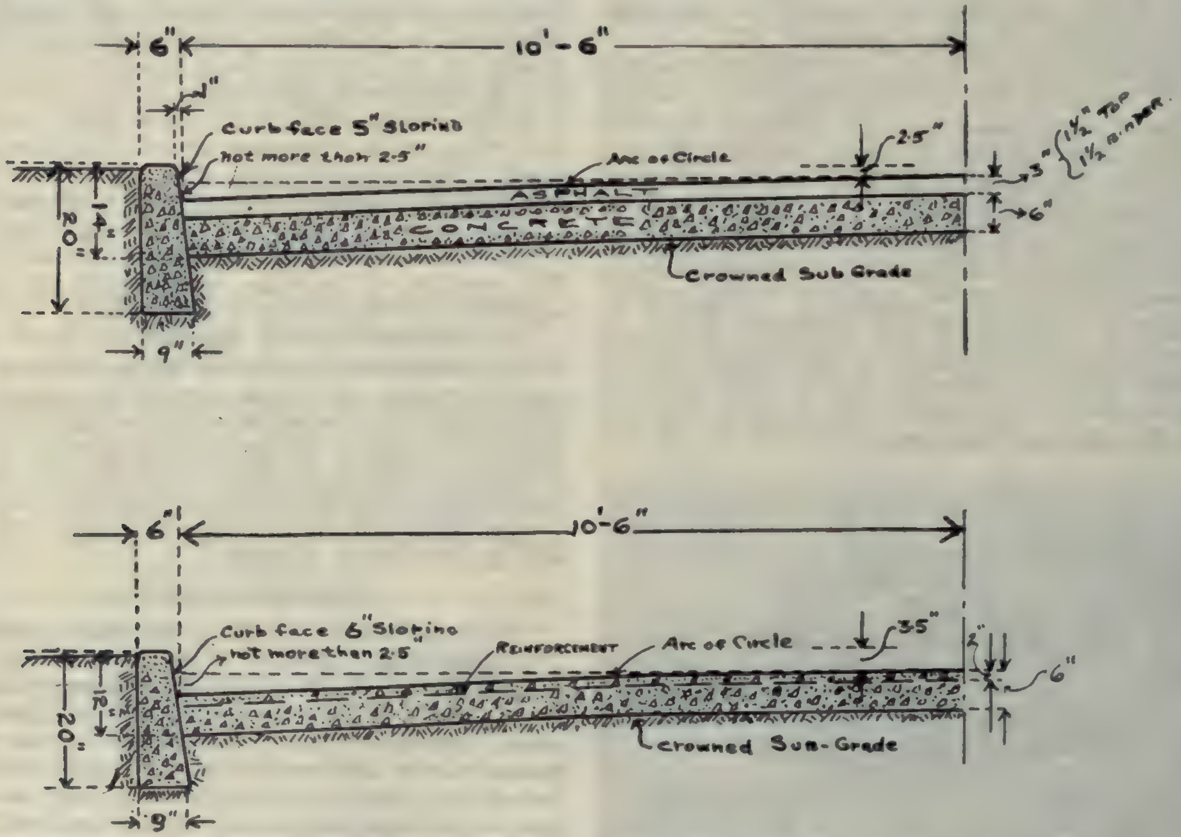
Needless to say the first work commenced was the repairing of existing pavements. The work of the plant for the first month of operation was devoted solely to this. The results obtained were so satisfactory that not a dissenting voice was heard, a most remarkable thing on a municipal job and which speaks for itself.

The mixture used in this patch work was a Standard sheet asphalt mixture. An average analysis of the mixture used in this class of work would be as follows:

| | | |
|---|---|---|
| Bitumen—soluble in carbon disulphide | 10.8% | |
| Passing 200 mesh sieve | 19 | |
| “ 100 “ “ | 9 | |
| “ 80 “ “ | 5 | 33% |
| Passing 50 mesh sieve | 30 | |
| “ 40 “ “ | 14 | 33% |
| Passing 30 mesh sieve | 5 | |
| “ 20 “ “ | 9 | |
| “ 14 “ “ | 9 | 23% |
| | | 100% |

Penetration of asphalt cement at 77 deg. F. 58 to 63.

The usual procedure in patch work of first thoroughly cleaning out the hole to be patched and painting with the aphalt previous to laying the patch was carried out. The thickness of the patches varied from a seal coat to 2 in. in thickness. The amount of this class of work completed in 1920 was 10.580 sq. yards.



Standard cross-sections of pavements laid in Chatham—Upper: sheet asphalt; lower: portland cement concrete.

The average cost of this amount was 99c per square yard including all material, cost of hauling, cost of manufacturing at the plant, cost of laying and losses.

### Reconstruction of Existing Pavements

Under this heading a few interesting methods of asphalt paving will be described which the reader may at some time or other find useful.

(a) **Reconstruction of a brick pavement 16 years old on William Street.**

The total yardage of this piece of work was 5528. The pavement was first thoroughly flushed and cleaned with ordnary flushers. After flushing, the surface was gone over with brooms and hooks to get all the dirt from the surface. Heavy material accumulated in the gutters wehre it was picked up and hauled away.

After the pavement had dried thoroughly it was painted with a Naptha cut back paint coat made by heating the asphalt cement from 275 deg. to 300 deg. F and adding one-third of naptha or gasoline. The cement gutters were also painted.

The wearing surface was then laid of standard sheet asphalt specification being on an average 2 inches thick compacted. This was laid from curb to curb covering the cement gutters as well as the brick. No binder was used underneath the wearing surface. The worst holes were brought to grade with the mixture.

The work was done as a 5 year local improvement.

The total cost is made up as follows on a square yard basis.

| | |
|---|---|
| (1) Material cost per square yard including sand, dust, asphalt testing, coal, power, gasoline oils. grease, etc. | $ .87 |
| (2) Plant rental charges | .20 |
| (3) Tools | .08 |
| (4) Labor—including manufacture at plant, hauling, rolling, etc. | .53 |
| Total cost per square yard | $1.68 |

A typical analysis of the finished pavement mixture is as follows:

| | | |
|---|---|---|
| Bitumen soluble in carbon dsulphide | 10.54% | |
| Passing 200 mesh sieve | 12 | |
| “ 100 “ “ | 11 | |
| “ 80 “ “ | 7 | 30% |
| Passing 50 mesh sieve | 24 | |
| “ 40 “ “ | 20 | 46% |
| Passing 30 mesh sieve | 7 | |
| “ 20 “ “ | [illegible] | |
| “ 10 “ “ | 4 | 24% |

(b) **Resurfacing an old hot-mix asphalt pavement.**

The total yardage of this work was 10,574 sq. yards. The street was first thoroughly washed with a hose so that it would be clean and dry when ready to commence work.

A naptha cut back asphalt paint coat was applied to the pavement similarly to that described in the former example at a temperature of about **300** deg. F.

Standard sheet asphalt mixture was then laid over this and thoroughly compacted to a thickness of one half inch, the bad holes prevously having been filled. Gutters were also covered to the curb.

This work was also done as a 5 year local improvement.

The cost is made up as follows on a square yard basis.

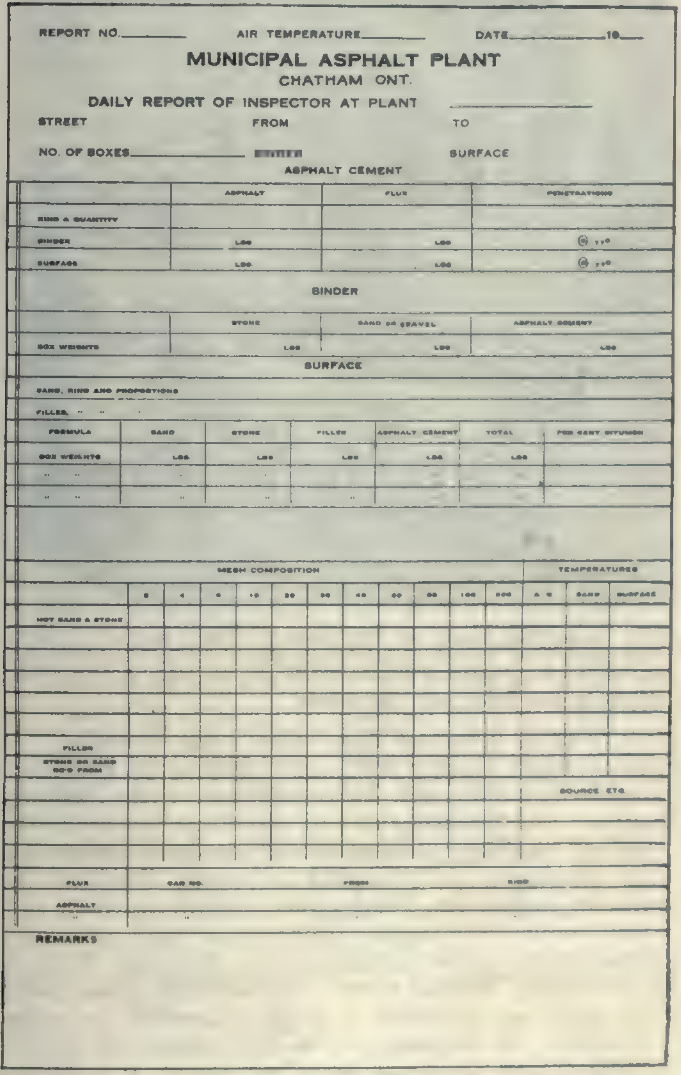
| | | |
|---|---|---|
| (a) Material | $0.47 | per square yard |
| (b) Plant rental charge | 0.20 | " " " |
| (c) Tools repairs | 0.08 | " " " |
| (d) Labor | 0.21 | " " " |
| Total cost per square yard | $0.96 | |

Analyses of typical samples ndicates a close approximation to those already given.

**c() Constructing an aphalt wearing surface on an existing waterbound macadam pavement.**

The total yardage of this piece of work was 2083 sq. yards.

On account of the thickness of the old waterbound macadam it was decided to ue it as a foundation and lay the asphalt wearing course directl yon top. Before doing this the surface of the old road was brought to a satisfactory grade by the addition of fresh crushed stone and by thoroughly rolling with a 14 ton roller. It was when well swept after allowing traffic to assist in compacting the base for a period of a week.



REPORT NO.______ AIR TEMPERATURE______ DATE__________19___

MUNICIPAL ASPHALT PLANT
CHATHAM ONT.

DAILY REPORT OF INSPECTOR AT PLANT ______________

STREET FROM TO

NO. OF BOXES__________ [illegible] SURFACE

ASPHALT CEMENT

| | ASPHALT | FLUX | PENETRATIONS |
|---|---|---|---|
| RING & QUANTITY | | | |
| BINDER | LBS | LBS | @ 77° |
| SURFACE | LBS | LBS | @ 77° |

BINDER

| | STONE | SAND OR GRAVEL | ASPHALT CEMENT |
|---|---|---|---|
| BOX WEIGHTS | LBS | LBS | LBS |

SURFACE

SAND, RING AND PROPORTIONS

FILLER, " "

| FORMULA | SAND | STONE | FILLER | ASPHALT CEMENT | TOTAL | PER CENT BITUMEN |
|---|---|---|---|---|---|---|
| BOX WEIGHTS | LBS. | LBS | LBS | LBS | LBS | |
| " " | " | " | | | | |
| " " | " | " | " | | | |

| | MESH COMPOSITION | | | | | | | | | | | TEMPERATURES | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 8 | 10 | 20 | 30 | 40 | 50 | 80 | 100 | 200 | A C | SAND | SURFACE |
| HOT SAND & STONE | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| FILLER | | | | | | | | | | | | | | |
| STONE OR SAND REC'D FROM | | | | | | | | | | | | | | |
| | | | | | | | | | | | | SOURCE ETC. | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

| | | | |
|---|---|---|---|
| FLUX | CAR NO. | FROM | RING |
| ASPHALT | | | |
| " | " | " | " |

REMARKS

Form used in making reports on Chatham's asphalt plant

As asphalt binder consisting of from ¾ in. stone to chips and 1½ inches thick was then laid directly over the prepared foundation. This binder might be called an intermediate binder as distinguished from open and close binder. It held about 4½ per cent. btiumen and was laid and rolled so as to for ma smooth, regular surface for the wearing course.

The wearing course, showing a typical analysis similar to those indicated before, was laid on the binder course at an average temperature of 300 deg. F and raked to give a thickness of 1½ nches when compacted.

This work was done as a 10 year local improvement.

The total cost per square yard is shown as follows:

| | | |
|---|---|---|
| (1) Material cost of binder course, wearing course and crushed stone additions to foundation | $1.37 | per square yard |
| (2) Plant Rental charges | .20 | " " " |
| (3) Tools and repairs charge | .08 | " " " |
| (4) Labor—(includes Foundation | $1.01 | " " " |
| Total cost per square yard | $2.66 | |

A few other pieces of work were carried out besides those described before, one of these being the srufacing of a brick pavement around the City Hall wth ½ an inch of sheet aphalt in order to deaden the noise of passing vehicles. If this improvement lasts for three years, as it is expected to do, it will have served its purpose.

One point of interest which might be mentioned is that the asphalt mixture in each of these pavements constructed was brought flush to the faces of the curbs which is now beioming pretty well a standardized prartice.

In summing up it might be stated that the results obtained so far have more than satisfied the expectations of those in charge, especally when it is considered that it was necessary to break in an inexperienced asphalt paving force.

### This Year's Work.

Work at present under construction or already completed this season (1921) amounts to 20,000 sq. yds. of new work and 9,000 sq. yds of reshrfacing. It is expected that 15.000 square yards more will be completed by the end of the year.

All permanent work s beng constructed on the usual cement concrete base with curbs having a slight batter on the face. Sheet asphat with varying mixes for heavy or ight traffic is used as the wearing surface with 1½ inches of binder composed of 50%—¾ in. crushed stone and 50% gravel and approx:—5½% asphalt cement.

The price of materials is somewhat less this season than in 1920 and the efficiency of labor greater. It is expected that the costs of the asphalt work done this years will be considerably less than those indicated above which were based on labor 50c per hour, teams $1.00 per hour, asphalt $40.00 per ton, dust $8.00 per ton, crushed stone $2.40 per ton.

## Electrical Work on Canada Cement Bldg.

The Canadian Comtock Company, Ltd., has been awarded the contract for the electrical work in connection with the new building being erected for the Canada Cement Company, Phillips Square, Montreal. The general contractors are the George A. Fuller Company and the architect is E. I. Barott.

# $2,000,000 Store in Victoria for the Hudson's Bay Co.

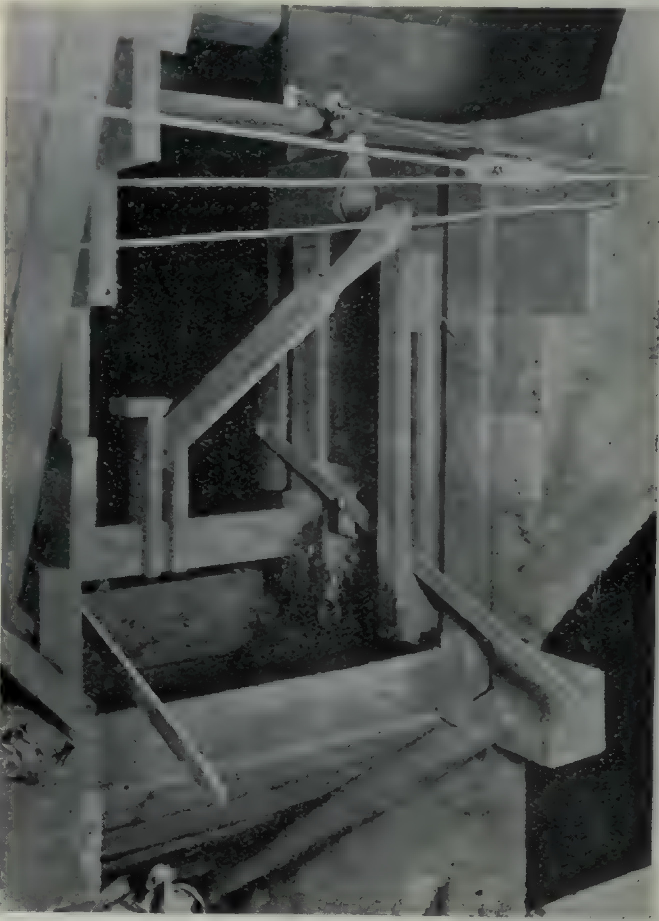
## Handsome Building Completed After Being Held Up During the War—Resourceful Method of Handling Concrete Results in Low Costs and Speedy Construction

Work has been completed, excepting the finishing touches, on the handsome new structure erected in Victoria for the Hudson's Bay Company, the general contractors, Messrs. Carter, Halls, Aldinger Company, of Winnipeg, having carried out the undertaking most expeditiously. This new block is to accommodate the general store business which the Hudson's Bay Company is opening in the provincial capital, which enterprise has been long delayed by war and other conditions. The walls of the structure were erected some years ago, but during the entire war period no effort was made to complete it, as it would have been an unpropitious time to attempt the stocking and opening of such a retail store as the Hudson's Bay Company will now have. Last year the announcement was made that the building was to be completed, and since then the various sub-contractors have been busy.

The building, which is a five-story block, with mezzanine floor and full basement, is located at the corner of Douglas and Fishguard streets, in the centre of the down-town shopping district. It is an imposing structure of reinforced steel and concrete of the beam and slab type, with ornamental terra cotta exterior. The ground floor is very handsomely decorated, ornamental plaster work featuring a hung ceiling, with cornice run on the beams, and ornamental caps on the columns. This floor, as well as the mezzanine, second and third floors, will be devoted entirely to the display of retail stock, and the space is to be laid out in the most modern manner. On the fourth floor, there is also considerable space to be given to sales and stock display. The various features of the new shop, such as rendezvous, restaurant, kitchen, general offices, board room, etc., are located on this floor.

The Hudson's Bay Company's new departmental store recently completed in Victoria, B. C.

In the arrangement of the interior every attenton has been paid to convenience and safety. There are two stairways from top to bottom for the public and a third for employees. These are all fireproof construction. The passenger elevator service is of ample capacity as three elevators have been installed. For the handling of goods to the various floors two freight elevators have also been installed. A parcel chute system will carry parcels to the basement where they will be distributed to the delivery routes. Accommodation of excellent type in the way of sanitary arrangements for both customers and employees is provided on every floor in the building, while the 'rendezvous' on the top floor is a rest room of ample proportions and attractive arrangement. The restaurant, on the same floor, is a splendidly lighted room, commanding a fine view. The walls are panelled in wood, enamelled in white.



The concreting plant for the Hudson's Bay Company's store was controlled by the three levers shown in the illustration, one controlling each of the two material hoppers and one for dropping the batch into the mixer.

While the building is not independent of outside services such as power, light and water, it is almost self-contained. In the basement are installed boilers, power production plant, including motor-generator for light, also the refrigerating and ventilating plant. The stack for the fire room is erected outside the building and is five feet in diameter with fire brick lining. Above the roof of the block rise the elevator penthouses and the fan room for the ventilation system.

In August of last year the general contractors, Messrs. Carter, Halls, Aldinger Co., Ltd., started work on the completion of the building. The bulk of the mechanical work, such as plumbing, steamfitting, electrical work, ventilating and refrigerating plant, had to be installed before the general contractors conld do much on their work. Early in the present year the concrete floors, floor fill, tile furring of walls, tile partitions and concrete stairways were started. Later the plastering and following that the wood floors and wood finishing and painting were begun. All this has been carried to completion by the combined efforts of contractors and architects in less than four months. The whole contract for completion has taken about ten months. The structure complete stands at a cost of approximately $2,000,000.

Showing one man operating the hopper gates.

Accompanying photographs illustrate the concrete plant used on this job, which will be of interest and value to other contractors. Discussing this method, which was adopted because applicable to the particular situation, Mr. J. C. Weston, general superintendent for the Carter, Halls Aldinger Company, says:—

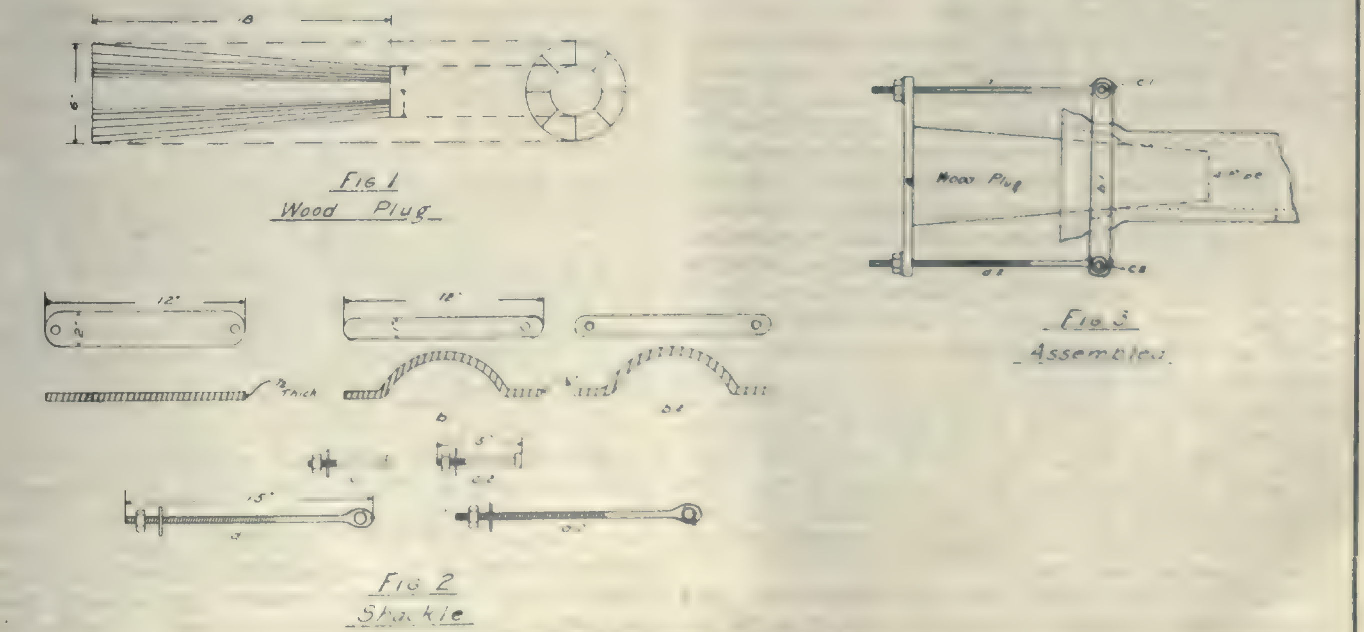
"We were able to team in onto the ground floor and we therefore put our mixer in the basement, dumping material through two holes in the floor into two hoppers, one for sand and one for stone. We had a control or feed gate on these hoppers, through which we fed a batch hopper, measuring the material by marking the batch hopper with nails. The cement was dumped in by the man who operated the hopper gates. When a batch was ready and the mixer empty, the centre lever was pulled down and the batch shot into the mixer. Three men operated the whole plant at a very low cost. Of course it is only adaptable to a like circumstance, where you can team right over your mixer, but its novelty and practicability will no doubt be interesting to many of your readers."

Messrs. Horwood & White, Toronto, were architects of the building, Messrs. Green & Lister, Winnipeg, are contractors for the plumbing, steamfitting, refrigerating machinery, wiring and motor-generators. Other sub-contractors were Architectural Bronze & Iron Company, Toronto, ornamental iron work; Otis Fensom Company, elevators. Other sections of the work were handled directly by the general contractors, Messrs. Carter, Halls, Aldinger Company.

## A Simple Plug for Testing Water Mains

By E. T. Austin, Manager, Water Works Dept., Belleville, Ont.

I have received several communications from contractors for a sure, simple, inexpensive plug for testing mains. Such a device is indicated in the drawing which shows a plug that has met the requirements, as we have tested this out for several years on 4 in.,



Details of temporary testing plug

Aug 10, 1921

6 in., and 8 in., pipe.

This plug can be easily made at almost any blacksmith shop or machine shop. The wooden plug should be of white pine or cedar.

If a vent is required to release the air from the pipe the wooden plug can be bored and a ¼ in. pipe with lock nut on the inside to make it water tight, and a valve put on the outside. This valve can then be opened as soon as the water is turned on, and the air will escape and the pipe line will fill to the end with water.

One contractor, after using the plug last win advised me that it was very satisfactory as the pipe line that he was working on had valves eight to nine hundred feet apart, and by using this plug he could test out every day and backfill before the frost had time to make it impossible.

[Very favorable comments on the device described above were made in an article by Mr. T. J. McLean, contractor of Wingham, Ont., which appeared in the Contract Record of May 11, 1921, page 460—Editor]

# The Growth of the Good Roads Movement

### The Development of Public Sentiment in Favor of Improved Highways—Increase in Automotive Traffic

By C. S. Lee, Director, Highways Improvement Service, New York

The growth of "the good roads movement" in the United States, since its organized inception in 1880, and with the great stimulus it received in the periods immediately following the advent of the automobile and the appearance of the motor truck, has been so rapid, so extensive and so effective that highway construction today constitutes one of the greatest, if not the greatest, problems in the economic life of this continent.

There are now 1702 organized agencies actively and directly pleading the cause of good roads. The automotive agitation, to date has brought about the construction of 310,000 miles of surface highways, raising the highway mileage of the United States to 2,478,552 and that of Canada to 225,000.

The automotive industry, with 369 manufacturing plants capitalized at $1,204,378,642 and employing 325,000 workmen; having an annual output of 2,205,197 passenger cars and trucks valued at $3,594,814,620, and supplemented, as it is, by 1,900 firms producing auto parts valued at $300,000,000 a year, together with 1,000 firms manufacturing annually 35,000,000 tires valued at $1,000,000,000, is absolutely dependent upon highway improvement for its stability and upon increased road mileage for greater expansion. In addition, 33,000 distributors of automobiles are involved as well as 45,800 dealers in automobile accessories and 35,000 dealers in tires. So great, too, has the road-building industry become, in consequence of the demand for improved roads, that there are now 7,500 contracting firms engaged in actual construction work. The roads are now traversed by 9,211,295 licensed cars and trucks, of which 3,000,000 are used on the farms. These cars consumed 3,200,000,000 gallons of gasoline last year.

Prior to 1880, when Amos G. Batchelder, late Chairman, the Executive Board, American Automobile Association at Washington, with H. S. Earle of Detroit and other pioneer advocates, organized the League of American Wheelmen and began a systematic campaign, a good roads enthusiast was looked upon with undisguised curiosity or amusement as something of "a nut"—a loquacious, but, no doubt, well meaning person who might be seen but not heard. Usually he was promptly "sat down upon" by the lugubrious taxpayer.

Opposition gradually melted away, however, as the campaign became more fully organized and extended. Since 1880 more than $3,000,000,000 has been spent for highway improvement in Canada and the United States. More than $1,300,000,000 is now available, and $1,500,000,000 additional will be necessary to carry out projects under contemplation. And yet, with all this, only a beginning has been made. Billions more must be expended before the country has anything like a highway system adequate to the traffic needs.

The demand for good roads and the progress made in road building has evolved many types of hard surfaced roadway, of which the bituminous are in greatest general use. The popularity of these types, especially those of the sheet asphalt, the asphaltic concrete and asphaltic macadam, is due to their long wearing qualities, resiliency against traffice impact, dustlessness, noiselessness, cleanliness and low cost of upkeep. Brick and concrete roads have also developed with the agitation as have the wooden block and granite block types. The most recent available figures give 42.11 per cent. of the surfaced roads in the United States as being of gravel, 25.22 per cent as of macadam, 17.16 per cent as of sand-clay, 10.98 per cent as of asphalt and other bituminous materials, 3.91 per cent of concrete and 0.62 per cent of brick. The figures for the asphaltic and brick types,— a total of 15.53 per cent show the extent to which the city types of pavement have been adopted in the rural districts. The wooden block and the granite block types do not appear to have progressed as yet beyond the city boundaries.

The extent to which the dustless types of pavement are being adopted is further shown by testimony given recently before the Senate Committee on Post Offices and Post Roads at Washington, by Thomas H. MacDonald, chief of the United States Bureau of Public Roads, whose tabulations showed that 107 Federal aid projects completed and paid for to May 25, this year, were roads built of bituminous materials.

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The first Canadian convention of the Society of Chemical Industry, which, with its many branches, covers the whole British Empire, will open in Montreal, August 22, with Sir William Pope, president, in the chair. It is anticipated that over two hundred chemists from all parts of the Empire will be in attendance, including representatives of the New York branch, the only outside branch.

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East end citizens of Toronto will probably not have to wait as long as at first anticipated to see the present lake front in their district improved. Ald. Cruise has advised that initial operations may commence about September 15, opposite the Woodbine Racetrack, under the eastern section improvement plan, providing the huge suction pump arrives from its present engagement on the Chippawa Canal.

# Factors Governing the Selection and Protection of Sources of Water Supply

By J. K. Hoskins, Associate Sanitary Engineer, U. S. Public Health Service

[Published as a supplement to the Public Health Reports]

A wholesome, ample, and satisfactory supply of water is one of the fundamental needs of any community, regardless of its size, and, therefore, the selection of the source of a supply having these qualities is a problem that has been solved or must be solved by every group of individuals forming a community, regardless of whether this group be the isolated family or the large city. The degree of success attained in the handling of this problem is quite closely related to the comfort, well being, and health of the community.

There are certain facts that must be taken into consideration in the selection of a suitable source of water supply, and these various factors must be weighed in the light of local requirements in order that that source may be chosen which most nearly meets the local needs. No absolute rules can be laid down for universal adoption, but general principles can be stated which, through long experience, have been found to be of value in reaching a wise decision. The following are some of the factors that must be considered: the nature and extent of use of the contemplated supply; the sources available; the quantity of water available; the quality of available supplies; the possibilities of pollution of the supply; the natural safeguards that may be employed for protecting the supply; and the cost of installation and operation of system.

### Nature and Extent of Use.

The nature and extent of use of a contemplated water supply will often determine the choice of a source. If water is to be used for industrial purposes, such as boiler feed water or for washing of white paper stock, evidently the qualities required would be different from those necessary in a water used for cooling or condensing purposes or for fire protection. If the supply is to be used for drinking and other domestic purposes, then other qualities are requisite, such as freedom from disease organisms, qualities not essential to a strictly industrial supply.

For obvious reasons the extent of use must be known. A small mountain stream might readily supply a village but be entirely inadequate for a growing city; or a well might be of ample capacity for one industry but totally unable to supply a community. The ultimate yield of any prospective source must always be considered and reasonable assurance obtained that it will always exceed the maximum anticipated demand.

### Sources of Supply.

After the nature and extent of use are determined, the selection of a source will evidently be somewhat restricted. It may be well, therefore, to discuss the various sources of water so that all available supplies may be given consideration.

Primarily, all available water is of meteoric origin. Water is evaporated from the ocean and surface of the earth, is condensed and falls as rain, and then flows either on the surface or underground, from higher to lower levels until the ocean is again reached, thus completing the cycle. It is therefore necessary to obtain a supply from some source within this cycle. Since the collection of falling rainwater is expensive and difficult, although often resorted to by individual families, the remaining sources, surface and underground waters, are usually those generally considered.

Collection of rainwater is usually feasible only for restricted use, such as individual families, because of the necessary surface required for such collection. Roofs are the most common collecting surface used, and the water drained therefrom is stored in various ways. Such storage should not be exposed to light because of the rapid development, under such conditions, of various organisms and plant life that will implant disagreeable odors and tastes to the stored water.

Surface water may be secured from flowing streams or from natural lakes. Water may be pumped directly from streams or it may be diverted into impounding storage reservoirs, and supplies of water are frequently drawn directly from them. Owing to the necessary contact with the surface of the earth and the existing polluting condition thus encountered, surface waters contain varying amounts of dissolved and suspended foreign matters that often render the supply objectionable and even unsafe.

That portion of the rain water falling on the earth that percolates through the surface layers and fills the interstices of the porous material encountered, is referred to as underground water. Owing to the close contact of such waters with the earth, ground waters frequently carry in solution considerable quantities of mineral substances, such as iron, salt, sulphur, limestone etc. Ground waters may be collected by means of wells reaching into the submerged strata, by springs, or by horizontal or inclined collecting galleries channeled or driven so as to intercept or divert the natural underground flow.

### Well Supplies.

Wells are of three general types: shallow, deep, and artesian. Shallow wells are what the name implies and draw their supply from ground-water storage of the surface earth layers. They are therefore frequently subject to gross contamination, and for this reason their use for domestic supply in urban communities is usually prohibited.

Deep wells are those reaching to the deeper water-bearing strata of the earth, thus drawing water from the truly underground sources of ground-water storage. Surface water is usually excluded from such wells by means of water-tight casings or linings extending from above the surface downward to the underground water-bearing stratum that furnishes the supply. Deep wells are driven, bored or drilled depending on whether the casings have been driven through soft strata, by means of blows, or bored through clay and similar easily penetrable material by means of augers, or drilled where harder strata are encountered. In some cases all three methods may have been employed on the same well.

Artesian well are those that flow, owing to underground hydro-static pressure. This pressure is usually developed by a warped, porous, water-bearing stratum being inclosed between two impervious layers, and receiving its water at a higher elevation than that of the ground surface at the point tapped by the well. Deep, non-flowing wells are frequently but incorrectly termed artesian wells.

Owing to the force of gravity, underground waters, unless impeded are in continuous motion. Because of various geological formations of impervious materials, the underground flow may be forced to the surface and form a spring. Such springs frequently exist in hilly country with underlying rock formations; they are often-times of considerable volume and may thus furnish suitable sources of water suply. Springs frequently form the sources of surface streams or emerge along stream channels, thus becoming part of the surface supply.

Infiltration galleries are usually tunnels, collecting pipes, or chambers constructed across the underground flow channels in such a manner as to divert the normal course of the underground water to central collecting points from which it may be taken as desired. The most advantageous locations for such works are generally at low points along the base of inclined impervious strata upon which pervious water-bearing strata are superimposed. Infiltration cribs have frequently been placed along stream channels, below the surface, thereby drawing part of the supply from underground sources and part from the surface supply of the stream. Owing to the uncertainty of the quality of the water thus obtained, it is inadvisable to use such a source unless further treatment is contemplated.

### Quantity of Water Available.

An important factor in selecting a source of water supply is that of sufficient quantity from the contemplated source. In reaching a proper determination on this question, capable engineering advice should be sought, for varying factors exert a most important role in the yield of different watersheds. Moreover, the determination of the probable maximum demand of water requires careful study. It should be borne in mind, however, that the amount of rainfall is always the maximum limit of available supply. Hence the volume and distribution of rainfall, the size of the catchment area, and the percentage of the rainfall that is actually available are functions of the yield that may be expected from any source. Each of these factors can be further analyzed into its component part so that an intelligent estimate can be formed of the weight or value of the whole. Thus, in the matter of a surface supply, the percentage of the rainfall actually running off is altered by such conditions as permeability of the top soil, evaporation transpiration, temperature and other factors.

In estimating the yield from underground sources, still other conditions must be given consideration. The nature extent and position of the various of the various geological formations largely determine the volume of underground water available in any region as well as the quality of the supply. A considerable knowledge of the geology of a regoin is therefore required if one is to judge competently the extent of an underground source of water.

In many cases the total amount of surface water available from a given source is ample, but owing to various conditions the run-off may be exceedingly variable and hence at certain seasons be entirely inadequate.. To tide over such dry periods, impounding or storage reservoirs may be necessary in order to retain part of the excess flow during the wet season and release it when needed. Many instances of such equalization systems are in operation.

The problem of securing a suitable quantity of water is therefore very frequently an engineering problem that requires considerable study and experience for its proper solution, and no such problem should be undertaken without the assistance of competent engineering advice.

### Quality of Water.

In the selection of a source of water supply, quality is a prime requisite, and this fact must be kept clearly in view. If a supply is deficient in quality, it can never reach the degree of usefulness that consumers have a right to demand regardless of the many other points it may have in its favour. There are numerous characteristics that determine the quality of a supply, but in general they may be grouped under three heads: (1) sanitary quality, (2) chemical quality, and (3) physical characteristics.

#### 1. Sanitary Quality.

The sanitary quality of a water has to do with its relative freedom from pathogenic organisms or those which cause disease or otherwise affect the health of persons drinking it. The most common disease organisms transmitted by water are those of typhoid fever, dysentry, and cholera, which diseases, because of this common mode of transmission, are frequently termed water-borne diseases. In some waters there are other forms of organic life present, organisms whose action is not definitely known but which are certainly not beneficial and may even be detrimental to health. To be of satisfactory quality, a drinking water must be practically free of pathogenic organisms, and the standards are being constantly increased to the point where practical freedom from all organic life may soon be required.

For ascertaining the sanitary quality of a water, carefully standardized methods have been developed which permit the making of detailed comparisons; and complete information should be had, in the light of these procedures, in regard to any contemplated source. These relate, in brief, to the bacteriological analysis and to the sanitary survey of the watershed. One bacteriological analysis is of comparatively little value but a series of such analyses, covering a considerable period of time and taken under a variety of conditions, gives a valuable index of the sanitary quality of the water. Such analyses, combined with a carefully made sanitary survey of the watershed with a view to locating and weighing the importance of all existing sources of pollution, will produce valuable evidence from which safe decisions may be made.

It is not the intention to discuss here the details of bacteriological technique of water analysis—water analysis has become a highly developed and well standardized science—but a few remarks on the broad featof its foundation may be of value in explaining its applicability to the question under discussion.

No practicable method has yet been devised to isolate the typhoid organism from water. Moreover, it has been done so rarely that the procedure is of no significance. It is entirely practicable, however, to isolate and enumerate a group of organisms similar in many respects to the typhoid organism, namely, the intestinal tract of human beings, and hence always present where typhoid organisms are found. This group, called Bacillus coli, is therefore in reality a more sensitive index than the typhoid organism itself; for while the latter would be found only where typhoid bacteria were actually present, the presence of B. coli is indicative of excremental pollution, either animal or human, which may or may not be of a dangerous nature, since the B. coli group itself is nonpathogenic. The permissible extent of occurence of B. coli in a water supply has been a much discussed question, and the fixing of any standard of this nature is difficult.

Bacteriological examination should not be the sole means of gauging the sanitary quality of a water supply, however, but should be made in connection with a thorough inspection of every part of the area with which the water may come in contact. All possible sources of continuous, intermittent, or accidental pollution should be examined and noted in order to estimate the real or potential influence of each such source on the sanitary quality of the water. The nature and extent of such possible sources of pollution will largely influence the methods to be inaugurated for the protection of the supply. Such serveys should be repeated at frequent intervals in order that detailed information may be complete and up-to-date. The sanitary quality of any supply is the most important factor to be considered, because even a temporary or periodic lapse of precaution may exact a toll of human lives from water borne diseases. Consequently too much care can not be taken to prevent such occurences.

### Chemical Quality.

While the chemical impurities found in water are not generally so detrimental to health as bacterial pollution, yet, from an economic standpoint, such impurities are often of such a nature as to demand careful consderation. Water is passing over or through certain mineral deposits, dissolves small amounts of these substances and carries them off in solution. Ground waters, because of the generally longer and more intimate contact with the earth, are, as a rule, more heavily impregnated than surface waters. The chemical features most ordinarily encountered are hardness, miscellaneous mineral content, and gases in solution.

Hardness in water is usually caused by the presence of salts of calcium and magnesium in the form of either sulphates or carbonates. These salts render the water objectionable for household purposes and some industrial uses because the calcium and magnesium unite with soap to form insoluble compounds, causing unsightly scums and precipitates, and thus render the soap uneffective. The added cost for soap in a community where hard water is used is greater than generally supposed. Whipple states that it requires 1 pound of average soap to soften 24 gallons of water having a hardness of 200 parts per million; or in other words, before a lather can be produced, a pound of soap is consumed in 24 gallons of such water.

Hardness is objectionable for many industrial purposes also, because of the deleterious chemical actions produced. Thus in dye and dyeing industries, sugar refining, texiles trades, tanning, paper making, etc., soft water is necessary. Used in boilers, hard water forms a scale or incrustation of the inner surfaces and greatly reduces the efficiency for steaming purposes, because of the low heat conductivity of the scale. Excessive scale even causes the metal tubes to burn out, resulting in the expense of replacement. Wherever possible, therefore, hard water should be avoided as a source of supply.

Water frequently contains other mineral substances that are objectionable; iron, manganese, and chlorides being among the number. Iron and manganese form red precipitates and may effect the taste of the water as well. They can generally be removed by treatment processes such as aeration and precipitation. Many well supplies, especially along the salt water coasts have a high chloride content which, on excessive pumping, tends to become even higher. The abandonment of such supplies is generally the only feasible remedy in such cases.

Waters frequently contain considerable amounts of dissolved gases, mostly carbon dioxide, and sometimes in the case of underground waters, hydrogen sulphide. Carbon dioxide imparts a rather pleasant taste but in considerable amounts, owing to its solvent qualities, may be accompanied by increased quantities of other minerals such as iron or manganese. If present in the free state, carbon dioxide will attack iron pipes and containers and cause serious trouble in distribution systems. Hydrogen sulphide imparts a disagreeable odor and taste. Oxygen and nitrogen are normally present in all surface waters and to a lesser extent in ground waters, and have a beneficial effect, especially the former.

### Physical Characteristics.

In addition to the above factors affecting quality, there is another group which, while not directly harmful to health, must yet be considered. Their presence in water may be said to offend the aesthetic senses and in that way divert consumers to the use of even unsafe sources of supply in which these factors are absent. Such factors are color, odor, taste, turbidity, and temperature.

Color in water is usually of organic origin and of a complex chemical composition little understood. Compounds of iron are sometimes responsible for mineral coloring in water. Vegetable color usually originates from water that has been in contact with swampy areas, dead leaves and vegetation, peat, etc., and varies in intensity at different seasons of the year, depending on the length of contact. Color can be removed by chemical treatment and filtration and to a certain extent by storage and exposure to sunlight.

Odor and taste are closely allied, both conditions usually being present in the same water. Odor in water may be caused by vegetable matter, microscopic organisms, or chemicals in solution. Many waters that are highly colored have a distinct odor of humus or musty wood derived from the vegetable matter from which they have been in contact. Microscopic organisms are a prolific source of a variety of odors, many of which are highly objectionable. Such odors are caused by oily substances generated by certain growing organisms and hence vary with the concentration of these organisms at different seasons of the year. They are most noticeable in stored waters exposed to light and air. These organisms on decaying give rise to still other kinds of odors and tastes that are mostly disagreeable. Certain chemicals may also produce marked tastes and odors, such as the paint of new water pipes or waste coal-tar derivatives from gas works and allied industries. Excessive dosage of water with chlorine gas or hypochlorite of lime also produces marked tastes at times.

Turbidity of water is caused by opaque substances held either in suspension or colloidal solution. Turbidity may be caused by clay, silt, iron, micro-organisms, organic matter, etc., and is generally more pronounced in surface waters. Underground waters as a rule are clear, with little or no turbidity. Excessive turbidity is most common in waters draining from clay soils and settles out more slowly when in this form. Turbidity can be reduced by sedimentation and storage and can be entirely removed by coagulation with chemicals, followed by filtration.

Temperature of water is of necessity a varying factor, depending on season, latitude and source. The temperature of surface waters fluctuates between much wider limits than that of ground waters, and for this reason the latter are generally preferred, if available, especially in warmer climates. Whipple states that when the temperature of water exceeds 60° F. it becomes unpleasant for drinking, and he further assumes that half the consumers would object to a temperature exceeding 66°, and all would object to a temperature of over 75° F. Another result of higher temperatures is an increase of microscopic organisms and plant life, with the consequent probability of increased tastes and odors.

The potential dangers and possibilities of pollution of any source of water supply should be thoroughly investigated and analyzed because of the direct bearing this group of factors has on the development of the source. Any community is usually limited to a comparatively few available sources of water supply, and the selection of any source must take into consideration the factors enumerated under this head, if not from the standpoint of acceptance or rejection, then from the standpoint of nature and degree of treatment necessary to counteract the effects of such pollution factors as are found to exist. Some of the factors requiring consideration under this head are geological formations of the area, surface scour and wash, vegetable and animal growths, and contamination by human agencies.

The geological formation of any area has much to do with the possibilities of pollution of water supplies. A tight clay soil offers much less possibility of wastes from a pit privy percolating to a near-by well than would a coarse gravel stratum. Fine, porous, sandy soils also act as natural filters and reduce the potential danger of pollution. On the other hand, cavernous limestone regions containing free underground channels where polluting wastes may be carried for long distances are highly dangerous. In fact the sewage from such cities in such regions is sometimes discharged into sinks with unknown outlets. Many instances are on record where peculiar geological formations have been the direct cause of serious epidemics of water-borne diseases.

Knowledge of the geological formation is also of value from the standpoint of mineral pollution of possible water-supply sources. Thus the underground waters of certain areas are strongly impregnated with sulphur, rendering such waters useless as sources of supply; other areas produce only highly saline waters, and still others have an abnormally high iron content. Even surface waters may be seriously affected by contamination with highly acid drainage from active or abandoned coal mines, or may be liable to be so contaminated if coal measures form a part of the geological strata.

### Pollution from Surface Wash.

Surface wash also plays a part as an active or potential source of pollution. High turbidities are mostly the effect of excessive surface scour, which brings to the stream a conglomerate mixture of polluting substances, including dangerous and offensive organic matter deposited on the watershed. Usually such pollution is highest at periods of high-stream flow, regardless of the increased dilution at such times. Flashy, quick spilling streams with wide and sudden variations in discharge need, therefore, to be carefully examined when considered as sources of supply. Forestation is usually conceded to have a deterrent action on soil erosion, and is therefore of value in the protection of watersheds, hence in the reduction of turbidity of streams.

Vegetable and organic growths also play a part in the possible pollution of water supplies. Water coming from some sources may be so heavily seeded with vegetable organisms at times as to render it almost unfit for use by imparting disagreeable tastes and odors. Water from pine forests and peat swamps may be highly colored and have tastes that render it very objectionable. Certain micro-organisms will also have a serious effect on tastes and odors if the source is not properly protected or if proper care is not exercised in storage and handling of certain classes of supplies. While these matters may not be regarded as polluting in the strict sense of the word, they are certainly factors that influence the use and popularity of the supply.

Pollution by human agencies is the greatest and most serious source of potential and actual contamination of water supply. The ways such pollution may reach a source of water supply are almost infinite. The only safe way to eliminate the possibility of such polluton is to remove the cause—that is all human contact, both direct and indirect, with the source. Just in so far as this is done will the potential danger be reduced in degree. Attempts to follow this course have been made by many communities, notably those having untreated surface supplies. The watersheds have been entirely depopulated, many of them reforested, and are being carefully patrolled to prevent even accidental pollution. The results obtained by these measures have justified them. Other communities have for various reasons not been able to inaugurate such complete measures or have found other safeguards better adapted to particular conditions. There is practically, however, no unused surface source of supply of any size in this country that is not in potential, if not actual, danger of pollution by human agencies; and any contemplated source of this nature should be provided with suitable machinery for its protection or the elimination of the pollution before being used for drinking water. Where pollution of the source is of such nature as to be impractical of prevention, then measures for removal of this pollution by some artificial-treatment process must be provided to safeguard the consumers.

### Natural Safeguards.

The detrimental effects of various agencies, both natural and artificial, on the quality of water have been indicated above. In the grand balance of forces which nature attempts to maintain there is another set of factors actively engaged in reducing these detrimental effects—natural safeguards that are of immense value in assisting to restore such polluted water to its original quality. Some of the most important of these safeguards that may be employed are forestation, natural filtration, aeration, impounding or storage, and plankton activity.

Forestation of extensive areas has a considerable retarding effect on the extent of the soil erosion and thus diminishes the amount of silt and clay reaching the watercourse. Moreover, the humus top layer of soil developed acts as a filter and natural storage medium for water falling on it and may thus tend to regulate stream flow. The effect of forests on flood prevention is a much controverted question. Forestation properly maintained on any watershed does, however, suppress the increase of human population in such areas and thus tends to hold in check the potential or actual dangers of human pollution. If rigidly enforced, such forestation may eliminate all resident population and thus greatly reduce the probability of dangerous pollution.

Natural filtration is a valuable safeguard in the purification of water. The continuous action of this agency is well illustrated in the low bacterial content and turbidity of ground waters; hence their popularity for drinking-water supplies. The extent of filtration depends largely on the nature of the filtering medium or geological composition of the soil. Fine sandy soils, being more porous, filter and retain larger quantities of water than closely compacted ones, and hence are more efficient in this respect. Clay and closely compacted soils, while excellent filters, allow such small volumes of water to pass that they are deficient from the standpoint of quantity; the greater part of the rain falling on them is shed as surface water.

The process of natural filtration is rather complex and makes use of various agencies for effecting the result. There is first of all a straining action by which larger particles, and some smaller ones as well, are prevented from passing through the filtering layers with the water. In addition there is a great reduction of velocity of the liquid which causes deposition of suspended matter and, by increasing the time of flow, permits the death of organisms to proceed within the filtering medium. Moreover, the grains of the filtering material finely divide the water passing through, and thus facilitate the oxidation of impurities by means of the oxygen carried in solution in the water. Filtration is therefore a combination of mechanical, biological, and chemical processes.

Aeration is a natural safeguard that is most active in self-purification processes. The benefits are those caused by bringing the oxygen contained in the air into intimate contact with the impurities in the water, and thus hastening the oxidation of unstable compounds by providing ample supplies of oxygen for the biochemical reactions taking place. Since oxygen is being continuously absorbed by water surfaces for this purpose, the extension of exposed water surface facilitates aeration. This extension may be effected by waterfalls, riffles, or turbulence caused by irregularities in stream channels, or even by artificial devices. Aeration may at times have a certain mechanical effect by releasing gases that are held in solution and that impart odors and tastes, such as hydrogen sulphide or sulphur dioxide. Excessive carbon dioxide content of underground waters may also be released by aeration.

Impounding or storage of water affords a means for a certain amount of natural purification by facilitating sedimentation of impurities. Finely divided suspended matter, as well as some bacteria that will not settle in moving streams, will be dropped to a large extent where the velocity is sufficiently reduced. Storage also may permit the action of light to bleach and reduce color. Storage also provides time and generally suitable environment for the activities of bacteria-consuming organisms and biochemical reactions that have a beneficial effect upon the quality.

Another important factor in self-purification, acting as a natural safeguard, is the extensive variety of microscopic living forms that move about in the water and are commonly known as plankton. Plankton are of two general types—one being food producers which convert inorganic matter into organic compounds, and the other food consumers or animals which feed on the bacterial flora. The complete significance of plankton life and activity is not understood. However, some of the plant forms liberate oxygen from certain compounds and make it available for oxidation of organic matter in the water. The animal forms, by feeding on bacterial content, enormously increase the normal death rate of all bacteria in the water, pathogenic forms as well as others, and thus have a distinct bearing on self-purification. This class of plankton is most numerous where its food supply is most plentiful, and hence fluctuates in number with the bacterial content with which it comes in contact.

### Cost.

A primary factor in the selection of a source of water supply, and, in fact, often the governing one, is that of cost. Regardless of many other considerations, cost must always be taken into account and will at once rule out, in many cases, otherwise satisfactory sources. Costs should be carefully analyzed for any project and each item should be given its proper weight, especially in those instances where certain factors tend to offset the first cost of apparently more expensive systems considered from the standpoint of installation alone. Thus it might be cheaper to expend considerably more money to secure a naturally soft water than to install a cheaper hard-water supply and then pay for excessive soap waste and increased expense incurred by industrial users.

The factor of cost will also determine whether it is advisable to neglect largely the factors of existing pollution in a source and provide for the artificial purification of the water before use, rather than attempt to eliminate such sources of pollution or seek a source where such pollution does not exist. Because of the scarcity of naturally pure sources of supply and the prohibitive cost of making such sources satisfactory, various means have been developed for artificially purifying water. A careful analysis of costs should be used for securing a satisfactory supply in any individual case. Cost is therefore a factor that will usually have great weight in the selection of a course.

**Summary.**

The selection of a source of water supply depends on a number of factors, all of which should be given due consideration and weight before a choice is made.

Determination of the nature and extent of use of the proposed supply will at once indicate the inadvisability of selecting certain inadequate or unsuitable sources. Such determination will also make evident the necessity for accurate knowledge concerning the quantity and quality of water to be expected from various sources.

The possibility of pollution of the source is also a factor to be carefully considered, as well as the natural safeguards that exist or can be inaugurated that tend to counteract such pollution.

Finally the relative cost of supplies developed from various sources, carefully balanced against their advantages, will determine largely the source to be chosen. This factor may outweigh many other considerations and indicate the advisability of articficial purificaton rather than the selecton of an uncontaminated source.

# Contractors of Quebec Province Form New Association to Protect Their Interests

The Association of Building Industries for the Province of Quebec was formed at a meeting held n the Montreal Builders' Exchange on July 27. The main object of the association s to secure the co-operation of the builders' exchanges in the provnce in dealing with legislation and secondly, to link up the industry throughout the province. In other words, it is intended that the builders as a whole shall deal with any proposed legislation which affects their interests. Hitherto the Montreal Exchange has borne the burden of watching legislation, but the time has come when a united organization will be able to speak with authority for the entire province. The bringing into line of contractors n the smaller towns is part of this programme.

At the meeting on July 27, Mr. K. D. Church, president of the Montreal Builders' Exchange, was appointed chairman of the gathering, and Mr. D. K. Trotter, secretary, was appointed secretary. Those present were: Messrs. A. T. Alexander and J. T. Walsh, of the board of dirctors, Montreal Builders' Exchange; E. G. Brousseau, president of the Quebec Exchange; P. A. Galarneau, vice-president, and J. P. Lemieux, director of the same; while J. T. St. Pierre represented the French building contractors of the city of Montreal.

In the course of his speech, Mr. Church emphasized the need which exists for such an organization, making special reference to the Mechanics' Lien Law passed in 1916, the Scaffolding Act of last year, and a bill which was passed dealing with the heating of public buildings in the province of Quebec. With regard to thsse two latter measures he was not aware that any builders' organization had been consulted in the matter, the reason probably being tsat there was nobody in existence that could adequately express the views of the varied building interests of the province. The sole object of organizng this new association at the present time was that it might serve as an official mouthpiece for the construction interets of the whole province so that it might be in a position to give the provincial government, and especially the departments of public works and labour, the benefit of their experience.

After it had been unanimoosly agreed to form the association, with the name of the Association of Building Industries for the Province of Quebec, the following officers were elected: Messrs. K. D. Church, Montreal, president; E. G. Brousseau, Quebec, 1st vice-president; Alphonse Gratton, Montreal, 2nd vice-president; D. K. Trotter, Montreal, and J. P. Lemieux, Quebec, joint secretaries.

The draft of the constitution and by-laws was approved, Messrs. J. T. Walsh and D. K. Trotter being appointed a committee to incorporate amendments from the meeting. It was agreed that before being finally approved, the revised draft should be submitted to the builders' exchanges of Montreal and Quebec.

It was decided to hold the first annual meeting of the new association in Quebec city, the date to be fixed according to the time of the opening of the legislature.

The organizaton of local exchanges at Three Rviers and Ste. Hyacinthe was referred to a special committee, and the hope was expressed that the new association would have the general effect of stimulating and developing the activities of other branches outside Montreal and Quebec cities.

The delegates in attendance were in the evening the guests at dinner of Mr. K. D. Church at the Engineers' Club. At the conclusion of the dinner a vote of thanks to Mr. Church and the Builders' Exchange for their courtesy was proposed by Mr. Galarneau.

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## Batts, Limited Change Name

The name of Batts, Limited, door manufacturers, has been changed to Buyer's Door & Manufacturing Company, Ltd. The Messrs. Batt severed their connection with the firm some three year ago but the business remained under the same manager, Mr. John S. Bond, who has been associated with the firm for eighteen years, first as superintendent and for some time as manager. A brother, Mr. Thomas G. Bond, who has been superintendent of the plant since 1918, will continue in that capacity. He has been connected with the firm for some fifteen years.

The plant of the Buyer's Door & Manufacturing Co., Ltd., is situated on Pacific Avenue, West Toronto. They are manufacturers of veneer and pine doors, which are marketed in all parts of Canada. They are also manufacturers of staved columns, newel posts, frames, sash, flooring, interior fittings, mouldings, stairs, panelling, etc. Their mills and yards are thoroughly well equipped. Mr. Bond states that the high standard of goods established many years ago under the name of Batts, Limited, will be maintained by the new firm and that the establshed trade mark of "B.L." will be retained.

Mr. John S. Bond is vice-president and managing-director of the newly named company. He and his brother come of a family which has been associated with the lumber and timber business for three generations.

# The Manufacture and Testing of High Tension Porcelain Insulators

## A Practical Description of thc Processes Involved in Making and the Care Essential in Inspecting. Some Interesting Illustrations.

By A. D. ALLEN, A. D. Allen Inspection Co., Hamilton, at C. E. A. Convention.

It was brought to our attention that most of those engaged in the electrical profession, have but a vague idea of the processes involved in the manufacture of porcelain insulators. Upon the suggestion of one of your executives we prepared, illustrated with lantern slides, a brief paper covering the manufacture, inspection and testing of porcelain insulators. We are dealing with this subject not as ceramic engineers, but from our knowledge and experience gained from the inspection of insulators, during the last ten years, at the various insulator plants in the States and Canada. These lantern slides, which we are using to-day, are those which we secured at the Canadian Porcelain Company's plant in Hamilton and probably represent the latest developments in the ceramic art of making and testing insulators.

The materials generally used in the manufature of hard porcelain are ball clay, china clay, feldspar and flint. It is the function of ball clay to make the mass plastic or workable; the china clay strong and dense when burned; the feldspar of a definite fluxing point to render the mass perfectly homogeneous, and flint to prevent too great shrinkage. All materials must burn white and dense so that the final product may possess the requisite mechanical and electrical strength.

Flint occurs in nature as pure silica, which is washed free of impurities and pulverized to prepare for the potter's use. Feldspar occurs as a rock which is carefully sorted at the quarry and pulverized. Ball clay and china clay are both aluminum silicates having their origin in feldspar deposits, which has weathered and from which the potash and soda have leached away. China clay usually occurs in nature mixed with mica and some free silica, which is removed by washing before shipment to the potter. It is weakly plastic. Ball clay is seldom treated in any way other than to weather in order to thoroughly break it up and permit maximum development of its prime characteristic of plasticity

Flint and feldspar occur in nature as rock and require pulverizing before introduction into the mixture. For this purpose grinding cylinders as shown in photograph are provided and in order that no foreign matter may be introduced into the raw material these cylinders are lined with porcelain brick and half filled with flint pebbles. A charge of flint or spar is introduced through the manhole in the side of the cylinder, the proper amount of water added, cover put in place and the whole cylinder rotated till the flint or spar is reduced to the proper state of fineness, after which the cover is removed and the mixture of water and flint, or spar, run out into the blunger for final mixing with other ingredients.

The liquid flint and feldspar mixture from the grinding cylinders is received into a mixer or blunger to which is also added the requisite amount of ball clay and china clay. These latter materials being by nature very finely divided are merely dissolved or distributed in the flint-feldspar mixture. The resultant liquid of the four ingredients is at nearly the consistency of very thick cream and in potter's language is know as "slip."

"Slip" or liquid clay from the mixing machinery contains more or less foreign material which must be removed by careful sieving in order that the "Body" or porcelain structure may be free of voids which would be caused by the burning or fluxing of foreign materials. For this purpose a shaking sieve is provided having a bronze screen containing in excess of 15,000 holes to the square inch. Two such screens or lawns through which all liquid must pass give absolute assurance of the cleanliness of clay solution.

The mining and shipment of the potter's raw materials entails much handling with the consequent introduction of more or less foreign matter, much of which is entirely harmless, but a certain amount of metallic iron is certain to become mixed with the clay and as such iron is hurtful it is desirable that it all be removed before forming the articles. Such cleaning of metallic iron is most easily accomplished while the clay is still in a liquid state, when it is easily passed by the poles of a powerful electric magnet which effectively removes all magnetic materials.

Up to this stage the clay is in the state of thick "slip," or cream-like consistency and a considerable portion of the water must be removed to produce a workable plastic mass capable of being worked into the desired shapes. Fig. 1. shows a pressure pump and filter presses, by means of which excess water is removed leaving a so-called leaf of plastic clay ready for working. Liquid clay enters at one extreme of the press and is forced at considerable pressure into the canvas lined cavities where separation of the water and clay substance takes place. When filled the iron plates are separated one by one and the leaf of clay removed after which the plates are again put in position and filtering resumed.

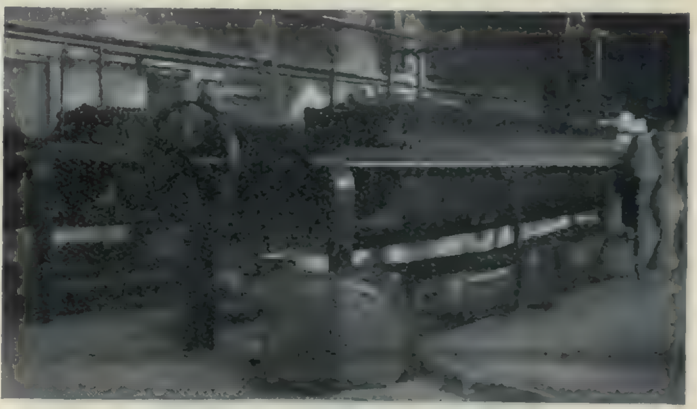

Fig. 1. Pressure Pump and Filter Presses.

Plastic clay from the presses is seldom sufficiently uniform to permit manufacture of ware. It is necessary therefore, to work out all air pockets and bring the mass to a state of perfect homogeneity in order that the finished product may be free of voids and planes of weakness. This necessary condition is performed by passing all clay through a mill. It is essentially a tube in which revolving cutters on a vertical shaft force the clay powerfully against a horizontal revolving worm or screw, which causes the clay mass to be extruded from the orifice at the bottom homogeneous in state, and of a form to permit ready working to the desired shape.

Art ware is formed by clay largely by hand and is essentially an expression of the individual workman's skill. Clay products of technical service must however, be made with great exactitude and it is necessary to substitute machine work for hand work. Nearly all electrical procelain, especially high voltage insulators, are made in plaster of paris moulds Such moulds are cast from exact plaster models. The exterior of the mould is usually framed by a cast iron ring machined accurately so that the finished mould will produce a product surprisingly exact in dimension. It is in the mould the plastic clay is finally shaped and it is the office of the plaster to absorb water from clay, and stiffen sufficiently to be handled. Moulds are made oversize to compensate for the inevitable shrinkage which occurs in the subsequent drying and burning of the ware.

The Potter's wheel, familiar to all ages, is still an essential tool in many clay working plants, but it is to-day a motor driven affair arranged mechanically to produce rapidly and accurately.

When large production is essential or where a screw thread is required the insulator press is utilized. As in the potter's wheel a plaster mould is used to form the exterior of the article, but in this process the interior of the article is formed by a plunger, which is made to rotate in either direction by powerful reversing clutches. At the completion of the downward stroke prompt reversion takes place leaving a mechanically accurate screw thread in the ware where required. This machine is equally serviceable in producing ware without screw threads, since the powerful pressing tends to produce denser and more homogeneous structure in clay wares

The surface of clay ware made in plaster moulds is seldom perfectly smooth, and it is generally necessary to trim the surface of the clay product to an even surface.This may be done immediately after removal of ware from mould, when in a leathery state, or finishing may be deferred till the article is entirely dry.

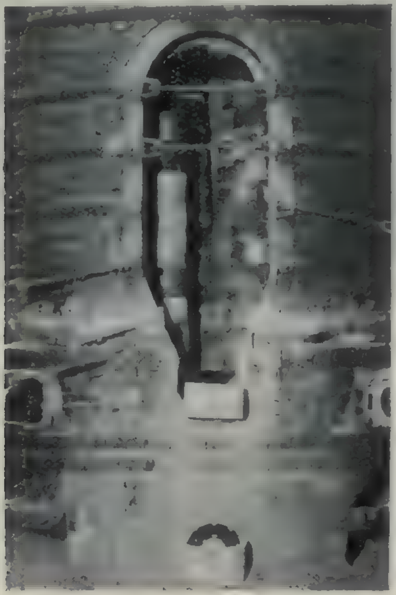

Fig. 2. Oven Shown in Section.

Clay wares made in the plastic state contain considerable water, which it is necessary to remove before applying glaze, and in the case of heavy pieces required in modern insulators it is essential that this drying proceed properly else internal strains develop resulting in an electrically weak structure of short life. When dried in the open air heavy pieces are cooled by evaporation from the surface, with result that the drying is held up, and further, the interior is still moist when the outside is comparatively dry, resulting in minute hair cracks in the surface, as well as internal strains. A proper drying system requires the use of high temperature and high relative humidity, in order that the whole mass of clay may become thoroughly heated before any drying may take place. Once the clay mass is entirely heated the relative humidity may be reduced, while the temperature may be increased and drying progresses uniformly throughout the piece without producing strains or cracks

Following complete drying of prepared ware all pieces are carefully inspected and blown clear of dust or other accumlations by a powerful stream of compressed air, in order that the glaze solutions in which they are dipped may adhere uniformly. The glaze solution is made up of clay, feldspar and cooling oxides, ground together to extreme fineness. The presence of excess feldspar in the glaze causes it to melt into a thin coating of glaze when subjected to the high heat of the kiln. No lead or other soluble oxides are used in coating electrical porcelain, since their presence would cause the insulators in the course of time to present a slightly conducting surface. Basically all glazes are alike, the only variation necessary being in the coloring oxide, for white—tin, for brown—iron, for green—chrome, etc.

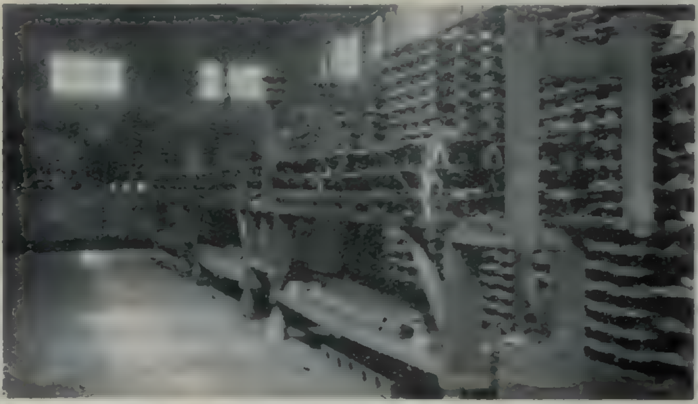

Fig. 3. A Rack of Insulators Ready for Tast.

At kiln temperatures the glaze substance becomes nearly liquid and so spreads itself uniformly over the surface leaving a perfect glass like finish. Parts in contact with the pot or saggers in which the material is placed for burning, must be left free of glaze to prevent adhesion. Where a complete envelope of glaze is required on the ware it may be supported, if light in weight, on small fire clay points, or if heavy, article may be placed in sand which of course adheres to the surface where in contact. Such sand surfaces are sometimes applied for the purpose of presenting a roughened surface to facilitate cementing.

The pots in which high grade ware are burned are termed "saggers" and are usually made of fire clay, formed on a potter's wheel to the required shape and burned sufficiently hard to develope the requisite strength for the support of heavy clay wares.

The final operation in the production of porcelain is the process of burning, which is accomplished by gradually heating the ware until vitrification takes place, producing a dense, homogeneous product.

The oven in which burning takes place is shown in section Fig. 2. It is essentially a bee hive affair 18 ft in diameter, by 50 ft. overall height. The interior space of such an oven is packed full of saggers containing the ware to be burned, and a slow fire started in each of the ten fire holes. Fuel may be coal, gas, or oil, all of which are in wide use. At the expiration of 24 hours the entire contents have reached a dull red heat, and as all water has been removed the fires are increased and the temperature raised to 2500° F. The firing period usually extends 60 hours and indication of satisfactory finish is registered by electric pyrometers, pyrometric cones and sample discs of ware which are periodically withdrawn and measured to ascertain shrinkage.

After firing has ceased, a period of 48 hours is allowed to elapse before opening the kiln in order that no cooling strains may be introduced in the burning ware.

After removal from the kilns the insulators are usually presented to the customer's representative for inspection in order to avoid further factory costs of handling defective ware. Much depends on the inspector, as no specifications have ever yet been devised which can be substituted for the good judgement of an experienced inspector in determining what porcelain should be put on the line and what should be rejected at the factory. Porcelain which is just under-fired or just over-fired is in general the most difficult to determine whether it should be accepted or rejected. Of course such defects as cracks, presence of an occasional foreign piece of matter in the body, warped, defective glazing, crooked assembly, etc.—are all readily detected and rejected.

The porcelain which has been accepted is then trucked to the pans for their first electrical test, where it is subjected to a voltage sufficiently high to break over the piece under such test. By proper proportioning of the piece the flashover voltage is usually 75 to 80% of its ultimate puncture strength, a safe value determined by many years of trial. The testing circuit is usually at 25 or 60 cycles, and so arranged that a snapping discharge around the porcelain is produced. Such a discharge oscillates at the natural period of the circuit and is found very effective in eliminating any defective porcelains.

The photograph, Fig. 3, shows a rack of insulators ready for test. The surface on which they are placed is metal and constitutes one electrode, the hanging chains dipping into the water with which the interior is practically filled from the other electrode, to which a voltage sufficient to flashover the articles is applied.The shells which have successfully passed over the tracks are then, if of the pin type, cemented, or if of the suspension, capped and pinned. After which operation they are inspected for cementing and assembly. Then those accepted are placed on the racks for their final flashover.

## Shawinigan Falls very Fortunately Situated with Regard to Ice Conditions

By C. R. REID, Electrical Superintendent.

The Shawinigan Falls power development is very fortunately- situated in regard to dealing with ice conditions in the river. The considerable expanse of quiet water in the upper bay is held at practically constant level by means of regulating gates, and the ice remains intact until the break-up in the spring. The ice sheet also covers the canal and fore-bay up to within a short distance of the racks. As a result of this protecting ice sheet, the water arrives at the racks free from all frazil or slush even during severe snow storms or other adverse weather conditions.

During the time the ice sheet is forming it is the practice to raise the upper section of the racks about three feet in order to prevent their being clogged with ice. A resistance type thermometer is installed in the forebay with indicator in the system operator's office. Whenever the temperature falls to 32.5 Deg. F., the work of raising the racks is begun.

In the spring after the ice has gone out, the temperature of the water remains close to the freezing point for some time. A cold night with a strong wind will cause the formation of frazil ice with surprising quickness. The only ice trouble experienced in recent years was brought about in this way. Since the installation of the head-race thermometor it is an easy matter to obtain warning of a dangerous drop in the temperature in time to avoid trouble.

The gate houses are heated electrically by means of 2200 volt three phase iron wire heaters. Motor driven blowers deliver the hot air, by means of metal ducts, to the head-gates and racks in order to prevent the adherance of ice.

A similar heating arrangement is provided for two inclosed regulating gates in the main dam. Since there is no spillway, the water level must be controlled by operating the gates. The two regulating gates have each a maximum discharge of approximately 3000 second feet, which is ample for ordinary conditions during the winter months. There are 20 main gates in the dam, each 40 feet long by 18 feet in height. Some views of these gates are shown in the illustration. These views show the ice behind the gates when they are first raised in the spring. During the winter the ice sheet is frozen solidly to the gates, but as soon as the weather turns warm, the heat of the sun, shining on the back of the gates, melts the ice free. As soon as the rivet heads will clear the ice, the gate is raised and the ice immediately above allowed to pass through. During a cold winter the ice will form down the face of the gates clear to the bottom. Sometimes when a gate is raised the ice dam will hold the water back for several hours before it gives away.

Trouble has been experienced when the gates were first raised in the spring, due to the ice giving way when the gate was partly raised. The ice forming on the gate is wedge shaped, with the thick end of the wedge at the top where it joins the surface ice. This wedge, if it passes under the partly raised gate, tends to force it upward and throw the hoisting carriage off the track. By raising the gates while the ice is still firm, troubles of this kind are avoided.

Two of the main gates are enclosed on the back with planking and were originally connected by piping with a steam boiler located in the building housing the regulating

Ice Dam Holding Water Back.

Water Beginning to Break Through.

Lower Ice Dam Completely Given Way.

gates. Whenever it was desired to raise one of the gates during the winter, steam was admitted, and in approximately four hours time the ice was thawed sufficiently to permit of the gate being raised. However, the piping was difficult to maintain in satisfactory condition, as the sudden rise in temperature, when steam was admitted, caused the failure of elbows and other fittings.

A year ago two 5 kw. electric heaters were installed in each of these gates and kept in service throughout the winter. These heaters were sufficient to keep the face of the gates free from ice at all times. Ice formed on the roller trains at the back, but it was not a difficult matter to clear it off when it was desired to raise the gates.

# Up-to-Date Methods of Lighting Buildings

## Benefits of Proper Illumination. Factors to be Considered in Design

There are few investments which give a better return than the money spent to procure good lighting either in the factory or the home.

It is now generally recognized that good lighting in a factory or office building will increase production, decrease accidents and improve the general health and contentment of employees. In some sections of the United States this is so well understood that legislation has been enacted which not only compels good illumination in industial plants, but actually states the value it shall have for different classes of work.

It will usually be found that it costs very little, if any, more to obtain good illumination than it would to have poor illumination. A careful study of the problem before installation will usually result not only in improved lighting, but a lower ultimate cost, and is much to be preferred to the usual haphazard method of locating outlets so often practiced.

To obtain satisfactory lighting the following factors should receive careful consideration, as they all more or less affect the final result and upon the proper weighing of their relative importance depends the ultimate success of the scheme:

(1) Nature and color of wall and ceilings.
(2) Spacing of light units.
(3) Type of reflectors or glassware.

Factor 1 is of great importance, since the relative light absorption of different colors and surfaces vary greatly; for large rooms and using proper reflectors the effect of the wall covering on the illumination may be minimized. While walls finished with a high white gloss are the most effective for reflection qualities. It must be borne in mind that a large expanse of wall surface painted so light as to reflect a large volume of light into the eye is objectionable for office and residence work, or any room where the occupants are likely to sit more or less directly facing the walls for considerable periods of time. Walls finished in buff, light greens or grays will be found usually more favorable than dead white for office buildings. In factory and warehouse buildings it will be usually found that a good washable white finish is the most effective wall covering to use.

### Factor 2—Spacing of Light Units.

A single light unit is usually less expensive to install and maintain and is usually more efficient than a cluster of lamps having the same candle power. The spacing of the units will depend upon the power of the individual units used and the intensity of illumination required. Generally speaking, individual units of 250 watts are large enough for small factories, 100 watt for offices and 40 watt for residences. Several outlets distributed over the areas to be illuminated will usually be found to be more efficient and to give a more pleasing effect than concentrating the light into one or two units.

### Factor 3—Type of Reflectors or Glassware.

The proper choice of reflectors or glassware has more effect upon the general satisfactory results obtained than anything else, since it is upon this choice that absence of glare and uniformity of illumination so largely depend.

There are three systems to choose from:

(a) Indirect.
(b) Semi-indirect.
(c) Direct.

With indirect lighting the ceilings and walls are utilized for the re-direction and diffusion of the light. Owing to the ceiling acting as a light, source glare is avoided and shadows are soft. This method has its special place in such locations as picture houses, art galleries, etc., but is now little used for general purposes.

In direct lighting the units send the light directly to the surface to be illuminated. Reflectors and glassware are generally used to improve the light distribution and diffuse the rays and give the effect of a large source of light and tend to obviate glare. The glare is further minimized by frosting the glass or, in the case of open reflectors, by frosting the bulbs. Shadows can be softened by the use of proper reflectors or glassware; in fact, as has been stated, the success of a direct lighting system depends largely upon the proper selection of reflectors and glassware, and with the enormous variety now on the market practically any requirements can be met by the use of standard material.

Semi-indirect lighting contains the features of the direct and indirect. With correctly designed fixtures the soft effect of indirect lighting may be obtained with the vertical illumination as obtained from direct lighting, and at the same time the shadows may be graded down to the required depth.

### Factory and Warehouse.

For factory and warehouse work the intensity of illuminating required, cost of fixtures, presence of dirt and dust, practically exclude any system other than direct lighting. In choosing the fixtures and reflectors consideration should be given to ease of cleaning, liability of surface to collect dust, etc., as well as their value as light distributors.

In offices and public buildings the indirect or semi-indirect may often be usefully employed, the latter particularly lending itself to decorative effects and harmonizing with the architectural designs of the buildings, although it will usually be found necessary to add a few direct lighting units to emphasize certain features of the building.

For private houses the semi-indirect lighting is very suitable for dining rooms and reception halls, but the actual selection of fixtures for a residence is so much a matter of personal taste that it will usually be decided by the owner, apart from any suggestions he may receive.

### Standard of Illumination.

The most suitable standards of illumination for various purposes can well be taken as given in General Electric Review, Vol. XXI., No. 6. They are as follows:

| | |
|---|---|
| Auditorium, church, etc. | 1.5— 3 |
| Armoury, public hall | 2— 4 |
| School, class room, library, etc. | 3— 6 |
| Store, show windows | 10—50 |
| First floor department | 7—10 |
| Clothing, dry goods, millinery, etc. | 4— 7 |
| Cigars, grocery, meat, bakery, etc. | 3— 5 |
| Office | 4— 8 |
| Drawing office | 8—12 |

Industrial:

| | |
|---|---|
| Rough manufacturing such as rough assembly, rough forging, rough woodworking, ice making, pottery, lumber mills, etc. | 2— 4 |
| Medium manufacturing operations: | |
| Woodworking, rough machinery, rough bench work, automatic machine work, meat packing, paper making, laundries, etc | 3— 5 |
| Fine manufacturing, fine assembling, leather working, fine woodworking, fine lathe work, etc. | 4— 8 |
| Extra fine manufacturing, watches and jewellery manufacturing, engineering, typesetting, shoe manufacturing, enamelling, etc. | 7 and up |
| Building, exterior | 3—15 |

# Mainly Constructional

**East and West—From Coast to Coast**

The convention of the Western Canada Irrigation Association was held at Vernon, B,C., Juiy 26 to 30th,

Building permits issued for new buildings and repairs, at Montreal, for the month of July past, totalled $1.560,816.

Good progress is being made on the new Pantages Theatre at Hamilton, Ont., and it is expected the building will be ready ning on September 1.

The county council of Ontario County, Ont., at a special meeting held in Beaverton recently, unanimously voted the sum of $80,000 to be expended on highways within the county.

The new $1,500,000 store of thee Hudson's Bay Company, at Victoria, B. C., it is announced, will shortly be opened. This latest addition to the Hudson's Bay Company's string of stores brings the total to 11. It will house 40 departments and is constructed of concrete and terra cotta.

The Ontario Provincial Government has decided to postpone the construction of a government-owned cement plant, for t present at least, The reasons given for this decision are a falling market on this type of equipment and the likelihood of a temporary suspension of the construction of the permanent type of roadway in the province.

The employees of the Canada Cement Company, at Belleville, have organized a club, to be known as the Canada Cement Club of Belleville, and have been duly incorporated. The club will furnish meals and lodging to club members and will be equipped with billiard tables. dancing floor and gymnasium for the recreation and amusement of the members.

The Good Roads Committee of the County Council of Renfrew, Ont., met in the town of Renfrew recently and decided to reduce wages of teams employed on county provincial roads from $6 to $5 a day, and that of men from $3 to $2.50. The work-day is 10 hours. The price of board was reduced to 75 cents from $1 a day.

At a recent meeting of the Winnipeg Trades & Labor Council, the following resolution was adopted: To suggest to the Dominion Trades and Labor Congress the formation of a labor research bureau with dominion-wide field of operations to gather and tabulate data concerning wages, hours of work. costs of production, profits, living costs, methods of finance and kindred matters for use in labor disputes.

Representatives of the contracting interests and organized labor unions of Moose Jaw, Sask., met recently and unanimously adopted the proposal of a Joint Industrial Council. A sub-committee was appointed, composed of representatives of both factions to draft a constitution to be presented for approval at a meeting to be held soon. Mr. T. W. Stevenson, of the Federal Department of Labor, organized the meeting which resulted in the above move. Mr. Stevenson has been successful in the formation of Joint Industrial councils at Calgary, Edmonton, Vancouver and Saskatoon.

## Obituary

Mr. James E. Narraway, aged 21. surveyor, of Ottawa, Ont., was drowned recently at Snow Shoe Lake. Man,, where he was assisting in the surveying of the Ontario-Manitoba boundary line. No further details of the accident are available at this writing.

Mr. Alfred Haines. well known builder of North Devon, N.B., died recently at the home of his son. Mr. Benjamin Haines, in that town. Several fine buildings and bridge structures were built by the deceased throughout the maritime Provinces.

Mr. Robert John Cooper, of the firm Brown & Cooper, well known building contractors of Toronto, died recently at his residence. 303 Carlton Street, Deceased was connected with the above firm for thirty years in Toronto and had been a member of the Toronto Builders' Exchange since its inception.

William Gunn, contractor, died at his residence, Crescent View Apartments, Winnipeg, after a lengthy illness on July 24th. Mr. Gunn was 45 years of age, eldest son of Mr. and Mrs. John Gunn, formerly of Stonewall, Manitoba, but now resident in Winnipeg. He was born in 1876 at Renfrew, Ont. and came west with his parents in 1878 to Stonewall where he received his education. He entered business with his father under the name of John Gunn & Son. Ltd.. and carried on a business as general contractors until his death. He was married in 1902 to Miss Maude Rutherford of Los Angeles. California. There are two daughters and he is also survived by his mother and father, three sisters and six brothers.

Mr. J. G. Sing, prominent Canadian civil engineer and land surveyor, of Toronto, died suddenly from an attack of heart failure, at Meaford, Ont., a couple of weeks ago, Deceased, who had been district engineer for the Dominion Department of Public Works for the past eight years, with headquarters at Toronto, was born in Meaford on September 3. 1857. During his career he had carried out numerous commissions of outstanding importance. In 1881 he was appointed by the late Sir John A. Macdonald to survey the Dominion Government lands in the Northwest Territory along the line of the C.P.R. Later he surveyed for the Department of Indian Affairs the islands along the northeasterly shore of Georgian Bay. The following works were designed by him and carried out under his supervision: Western Channel, Toronto; harbor improvements, Port McNichol; terminal C.P.R. on Georgian Bay and at Tiffin: harbors at Midland, Hamilton, Cobourg, Owen Sound and Sault Ste. Marie. He was in charge of the proposed new harbor works at Toronto, and, with the consent of the Department of Public Works was retained as consulting engineer to the Harbor Commissioners. Toronto. He was also one of four commissioners' experts, and Chairman of the Advisory Board of Commissioners, to examine into and report on present and future needs and supply of pure water for the city of Toronto. In addition to being ex-President of the Engineers' Club of Toronto he was a member of the Canadian Society of Civil Engineers, Toronto Board of Trade, and the Ontario Land Surveyors' Association.

# NEWS OF CONTRACTS

## Period of August 3 to August 9, 1921

*Dominion Wide Service Exclusive to "Contract Record & Engineering Review"*

### Waterworks, Sewerage and Roadways

**Dublin, Ont.**
Jas. Jordon, Dublin, clerk Hibbert Twp. Council, has plans and will receive tenders until Aug. 17th for construction of drainage system.

**Jonquieres, Que.**
Council plans construction of concrete sidewalks at cost of $15,000. Ludger Lacroix, secy.-treas.

**Jonquieres, Que.**
Construction of extension to waterworks and sewerage system at estimated cost of $35,000 is contemplated by Municipal Council. J. F. Grenon, Engr., Chicoutimi, Que.

**Regina, Sask.**
Tenders will be received until Aug. 17th by H. S. Carpenter, Deputy Min. Dept. of Highways, Prov. Govt., for roadwork from Lipton to Dysart, Sask. Plans with Dept., Wm. Grant, 810 Canada Bldg., Saskatoon; J. R. Reid, Court House, Swift Current; F. G. Kissack, North Battleford. Accepted cheque for $700, payable to Deputy Min., or Guarantee Companys bond required.

H. S. Carpenter, Deputy Min. Dept. of Highways, Prov. Govt., has plans and will receive tenders until Aug. 17th for roadwork from Flaxcombe to north of Alsask, Sask. Plans also with Wm. Grant, 810 Canada Bldg., Saskatoon; J. R. Reid, Swift Current; F. G. Kissack, North Battleford; L. M. Atkinson, secy., R.M. No. 298, Merid, Sask. Accepted cheque for $1,000, payable to Deputy Min., or Guarantee Company's bid bond will be required.

**Sault Ste. Marie, Ont.**
Contract at $13,650 for pumping equipment for City is placed with Northern Foundry & Machine Co., Bay St. Contract at $1.68 per lin. ft. for 14-in. woodstave pipe is awarded to Lyons Fuel & Supply Co., Dundas St.

**St. Thomas, Ont.**
Construction of storm sewers at cost of $35,000 is contemplated by City Council. By-law will be submitted. W. C. Miller, Engr.

**Toronto, Ont.**
F. Barber, Engr., 40 Jarvis St., will receive tenders until Aug 13th for construction of concrete sidewalks on several streets for York Twp. Council.

**Watford, Ont.**
Plans are prepared for concrete pavement to cost $30,000 for Town. W. S. Fuller, clerk.

#### CONTRACTS AWARDED

**Bornholm, Ont.**
General contract for improvements to drain costing $15,000 for Logan Twp. Council is placed with Jno. Reid, Bornholm.

**Fort Qu'Appelle, Sask.**
Frank Rooney, Weyburn, Sask., is awarded general contract for construction of concrete sidewalks for Council.

**Hamilton, Ont.**
J. D. Armstrong, 871 Main St. E., has general contrat for construction of sewer for City.

**Montreal, Que.**
City awarded following contracts for paving, sidewalks, etc.: Five streets at $30,800, Siciliy Asphaltum & Paving Co., 60 St. Viateur St. E.; two streets at $31,329, Duranceau & Duranceau, 152 Hamilton St.; one street, Rondeau Corlier & Co., 3227 Christophe Colomb; one street, Bernard Brault, 2855 Rosemound Blvd.

**Orillia, Ont.**
General contract for reinforced concrete pavement for Town is awarded to Warren Bituminous Paving Co., Ltd., McKinnon Bldg., Toronto.

**Quebec, Que.**
Prov. Govt. awarded following contracts for road construction from Levis to Sherbrooke: 13 miles, Kennedy Construction Co., Ltd., 137 McGill St., Montreal; 7 miles Newton & Dakin, Sherbrooke; 3 miles, G. W. French, Sherbrooke; balance of work by day labor.

**Regina, Sask**
General contract for roadwork from Harris to Rosetown, Sask., for Prov. Govt., Dept. of Highways, is awarded to W. A. Dutton, Winnipeg.

**Sarnia, Ont.**
General contract for construction of concrete pavement costing $12,000 on London Rd. for City is awarded to Reid & Somers, Ltd., Guelph, Ont.

**Thetford Mines, Que.**
General contract for paving one street at cost of $60,000 for City is awarded to Trudel & Fils, St. Irenee Les Bains.

### Railroads, Bridges and Wharves

**Chicoutimi, Que.**
Plans are drawn for electric railroad costing $125,000 for San Tonio Railroad Co., Chicoutimi. S. Finiot, Engr., Chicoutimi.

**St. Ambroise de Chicoutimi, Que.**
Construction of steel bridge costing $20,000 is contemplated by Municipal Council. J. F. Grenon, Engr., Chicoutimi.

#### CONTRACTS AWARDED

**Birtle, Man.**
Municipality of Birtle awarded contracts for construction of concrete culverts to Carter-Halls-Aldinger Co., Ltd., Winnipeg, and Boyd & Smith, Foxwarren, Man.

**Gilbert Plains, Man.**
E. Pilgrim, Dauphin, Man., has general contract for construction of bridge for Municipality.

**New Westminster, B.C.**
General contract for construction of wharf for Triangle Chemical Co. is awarded to Fraser River Piling Co., Ltd., 324 Front St.

**Springfield, Man.**
General contract for construction of concrete culverts for Municipality is awarded to Western Engineering & Construction Co., 107 Florence Ave., Winnipeg.

### Public Buildings, Churches and Schools

**Ashcroft, B.C.**
Plans are being prepared for school for Ashcroft School Bd.

**Beauharnois, Que.**
Town Hall is being repaired at cost of $10,000. A. L. Mayer, secy,-treas.

**Castlegar, B.C.**
Plans are being prepared for school for School Bd.

**Grosse Isle, Que.**
R. C. Desrochers, secy. Dept. Public Works, Dom. Govt., Ottawa, will receive tenders until Aug. 22nd for erection of quarantine hospital costing $200,000. Plans with Dept., Ottawa; Clerk of Works, Pub. Works Dept., General Post Office, Quebec; Office of Dept., Grosse Isle, Que.; Assistant Mechanical Engr., Dominion Public Works Bldg., Place Royale, Montreal. Accepted cheque for 10 per cent. of tender required.

**Innisfal, Alta.**
Hall costing $10,000 is being erected by G.W.V.A.

**London, Ont.**
Mocha Temple Shriners plan to make a gift of wing to new Children's Hospital.

**Montreal, Que.**
A. H. Lapierre, architect, 30 St. James St., has plans and will receive tenders until Aug. 18th for excavations, concrete foundations and piers required for hospital for Notre Dame Hospital, 351 Notre Dame St. E.

**Oliver, B.C.**
Plans are being prepared for school for Prov. Govt.

**Thamesford, Ont.**
W. G. Murray, architect, Dominion Savings Bldg., London, has plans and will receive tenders until Aug. 17th for erection of Parish Hall for St. John's Anglican Congregation.

**Vancouver, B.C.**
Plans are being prepared for police station to cost $20,000 for city.

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## *Cost of Production Must be Reduced if We are to Meet World Competition*

What solution does labor offer to the Canadian problem of meeting competition from outside points where production costs have already been reduced? In some cases the answer is a demand for still higher wages; in others, the insistance is merely that material costs must come down first.

There is no single individual in Canada who desires to see the wages of efficient labor reduced one iota. It would be a fine thing if we could all be living on Easy Street—shorter hours each year—less energy expended at our work during those hours. But unfortunately we can't choose. We must meet world conditions, either that or build a high wall about our country—so high that no product of any kind can get in. But in that case what about the things we have to sell? No nation has ever yet succeeded in living entirely to herself and neither can Canada.

There is no alternative, then. We must meet world competition, both as to price and quality. We must get production costs down to a minimum.

If our products don't compete with the products of other countries, what becomes of our population—more particularly of our labouring classes?

That the pressure from Germany and other continental points is already being felt is evidenced by an article that recently appeared in the "Empire Mail," entitled "Germany's Confidence and Energy." Apparently the pressure being put upon Germany is strenghtening that country industrially—very rapidly. The only solution offered is "we must reduce our own costs of production." We quote from the article.

"There is every sign that the stimulus of defeat and of a debt which must be paid before the nation can consider itself free, is having the same effect on Germany to-day as it did in France in 1870. The settlement of the amount of reparations has made an end ot the feeling in Germany that results of energy and toil would go into the pockets of the Entente. True, the Entente still share in any increase of Germany's trading profits, and for this reason it seems that we must accustom ourselves to rejoice in all signs of her prosperity, so far as it does not directly damage ours. Whether it is sound economics to have placed us in this position, time alone wil show. In Germany, at all events, there are no doubts at all that under the conditions imposed on her, she is bound to prosper, Germans are inclined to rub their hands over Mr. McKenna's attack on the system of reparations decided on, and murmer gleefully, "Ah, the Englishman is a business man, and he sees, luckily for us, too late—that trust in the policy of France, who knows nothing of business, but is inspired by ignorant greed of money and racial hatred, has committed him to a plan which will make Germany the world's factory."

"It's not only the heads of the great combines (and every day the papers contain records of new amalgamations, till it seems as if Germany really must become one huge factory with a single board of directors, and Hugo Stinnes as chairman) who are so confident ot the future. The same spirit is noticeable in workers of all grades. All this is very encouraging for those of us who can imagine money, the mere medium of exchange, to be the source of all wealth, but for those who recognize that it is not that, the outlook is disquiting The German workers' wages in "world-value," will continue to be lower than those of the British, and payment of cash indemnities only further depreciates German exchange, thus making cheaper in "world-value," the sum—nominally constant in paper marks—which it cost the German exporter (who takes a "world-value" profit) to buy his man's labour. So with a falling German exchange, the cost of production goes steadily down, and the German can continually reduce "world-value" prices. There is only one reply to this competition—we must reduce our own costs of production. The British workman will be faced with the alternatve of accepting lower wages or no wages at all, for at the present high scale it will soon be quite impossible for British Goods to compete, and therefore, for the British workman's employment to continue. If he can be made to see that capital is makng a proportionate sacrifice—as it will have to do—there is no reason why, despite the fact that German labour (unless the mark improves out of all knowledge) is bound to remain cheaper than British labour, British costs should not reach such a figure as will enable our goods to compete with Germany in every market of the world. Germany has a handicap of the tax on exports of 26 per cent. which should balance the advantage of cheap labour, provided all our costs of production—not labour alone—can be got down to the minimum. Only in this way is there any hope of German industry developing sufficiently to pay our indemnity without throttling our trade in its unnaturally forced growth."

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Most of the grumblers in this world are people who could be well spared by it. The "do little people' talk the most.

# Prevention of Alkali Action on the Winnipeg Aqueduct

## Description of Underdrainage Work—Variation in Cost During Different Seasons—$30,000 a Mile is the Average Cost of the Undertaking—Comparisons of Camp Living Expenses for 12 Months

Following a report by the engineers of the Greater Winnipeg Water District to the Administration Board that serious defects were developng in portions of the newly constructed aqueduct, between miles 13 and 17 through disintegration by alkali action, a special board of engineers was appointed in May 1920, to investigate the nature and extent of these defects and to advise on any means that might be necessary to prevent further development of the action reported to be taking place. The aqueduct was designed to discharge 85 million gallons per 24 hours and to resist a pressure due to 20 feet head of water and 4 feet of backfall above the top. At this point it is circular in section, 8 feet internal diameter with 8 inch thickness of shell. The section is as shown in Fig. 1. It was built by depositing the concrete between the forms in the trench.

During the investigation the shell was exposed every 100 feet by pits being excavated 3 feet by 7 feet and down to the level of the invert. The disintegration was found to be patchy and variable in extent which by inspection of the concrete and chemical analysis of the ground water which scooped into the test pits, appeared to be governed by the amount of alkali salts in solution with the water and also by the density or nature of the concrete.

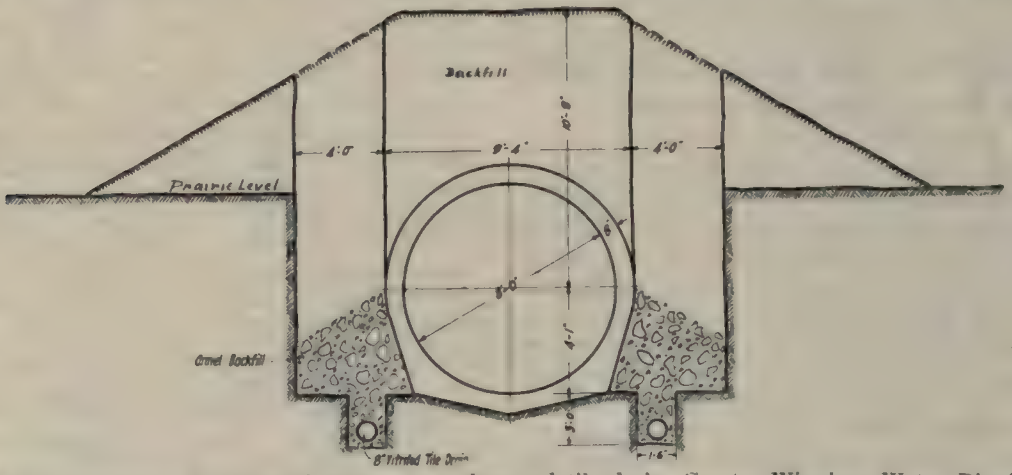


Fig. 1—Cross-section of reinforced concrete aqueduct and tile drain, Greater Winnipeg Water District.

As a result of the investigation the Administration Board decided to underdrain a portion of the aqueduct at mile 17, that gave signs of the most extensive disintegration. On the completion of the under drainage of this portion a further contract was awarded for the work to be extended to mile 16, and another later on for the remainder of the 4¼ miles of aqueduct, making a total length of trench, taking both sides of the aqueduct, of 8½ miles.

The plan of underdrainage adopted was that shown in Fig. 2, an eight inch vitrified drain pipe being laid with open joints in a trench three feet below the invert and covered with gravel, as shown in the drawing. The remainder of the trench was filled with earth in the usual way.

To take care of the drainage water it was first decided to sink a number of 5 inch artesian wells. This was done at mile 15 and 16 and the drainage system connected to them. On testing these wells it was found that they were each capable of taking 7,000 gallons of surface water per day without increasing the elevation of the water in the walls, but in the following spring the ground water was so abundant that the wells were flooded beyond their capacity; consequently another discharge was found necessary. This was obtained by connecting the underdrainage system of miles 13 and 16 directly to the drain pipe that was previously laid from the Seine river, about 7 miles further west, to mile 13, to take off the surface water that had no other means of getting away from this area. As there is a natural fall westward all along the aqueduct, it is considered that this drain will also take care of the overflow from miles 16 and 17.

The underdrainage work was commenced in June, 1920 at mile 17 and has been carried on continuously westward, there now being about 6 miles completed of the 8½ miles of trench for which contracts have been let. The first seven feet of the trench is excavated and thrown out by hand, the remainder is excavated by hand and removed by a traveller. The gravel for drainage over the pipes is taken from the railway track (which runs parallel to and 100 feet away from the aqueduct) to the trench by a belt conveyor rigged up by the contractors, shown in Fig. 3, and deposited in position by gravity. The backfilling is done by a Parson's gasoline backfiller, as shown in Fig. 4.

The average cost of the work is about $30,000 per mile of trench. The actual cost varies with the season, that done during summer and winter being about equal, that done in the fall and spring costing about 30 per cent. more, the highest cost being in March and April

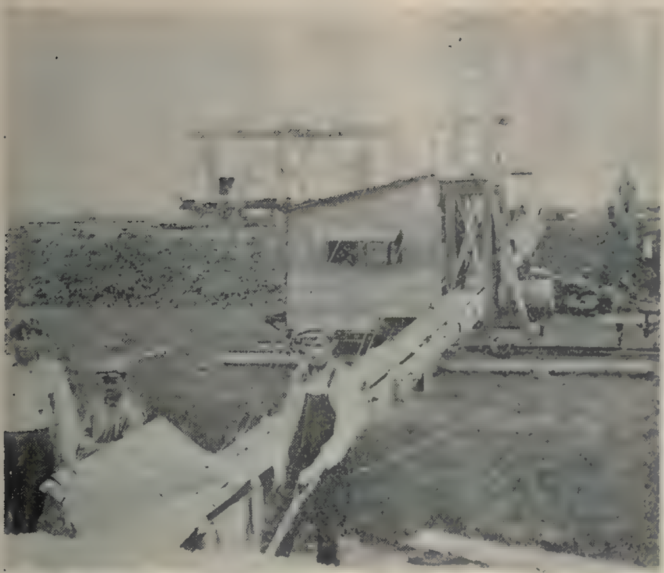


Fig. 2—Moving concrete aggregate from railway track to mixer 100 feet away by belt conveyor.

when the leaks in the pipe caused very wet working conditions. The penetration of the frost was greatest from December to March. This reduced the amount of timbering from that required in the summer. The amount thereby saved offset the extra cost of excavating, making the winter work as economical as the summer work.

A further interesting feature of the work is the comparative costs of camp provisions which show a reduction in the cost of living at the end of one year of approximately 50 per cent. The camp was established for 60 men and the cost of provisions from April to July 1920, was 44 cents per meal, July to December, 36 cents; January to May, this year 23 cents. Labor efficiency has been most satisfactory, the man hour output being equal to that of 1912-1915 period. Eighty per cent. of the men have remained constantly on the job, the remaining 20 per cent. remained for an average of 8 weeks.

The contract was awarded to Messrs. Fowler and Young of Winnipeg on a cost-plus basis with a guaranteed unit price, also a penalty and bonus of 50 per cent. on the variation of the cost, the penalty not to exceed half of the percentage on the guaranteed unit price.

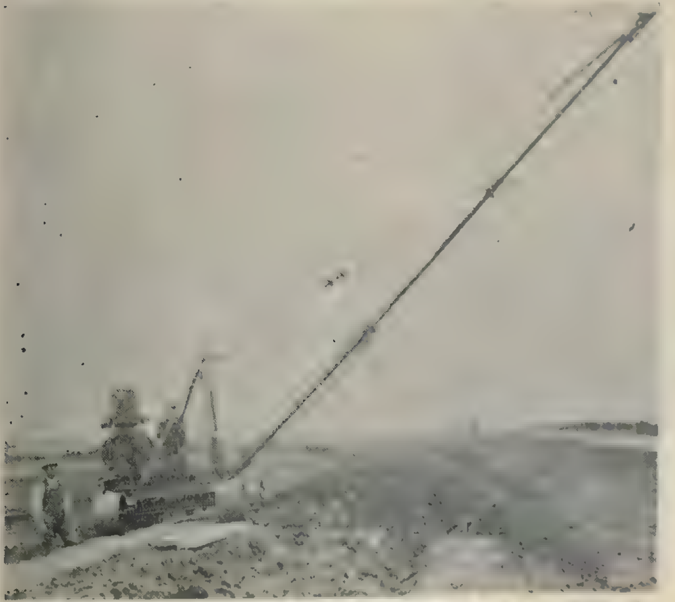


Fig. 3—Parsons gasoline backfiller operating on backfill of underdrainage of Winnipeg aqueduct.

The contract was awarded in the first instance for mile 17. When this was found to be working satisfactorily it was extended to mile 16 and later for the remaining portion of the work.

The supervision is carried on under W. N. Scott, commissioner, and W. R. Davis, acting chief engineer of the Water District.

Twelve miles of the aqueduct between that now being underdrained and Winnipeg were provided with an underdrainage system when built. It is now intended to install permanent testing tubes at intervals along this portion to ascertain if the original underdrainage is accomplishing the results intended. Eighty 6 inch test pipes are to be sunk below the level of the aqueduct invert from which samples of the ground water surrounding the aqueduct will be taken from time to time to determine if any alkali-saturated water is resting against the concrete structure. The aqueduct between mile 26 and the intake at Shoal Lake, about 60 miles further east, is not at present thought to be affected by alkali-laden ground waters.

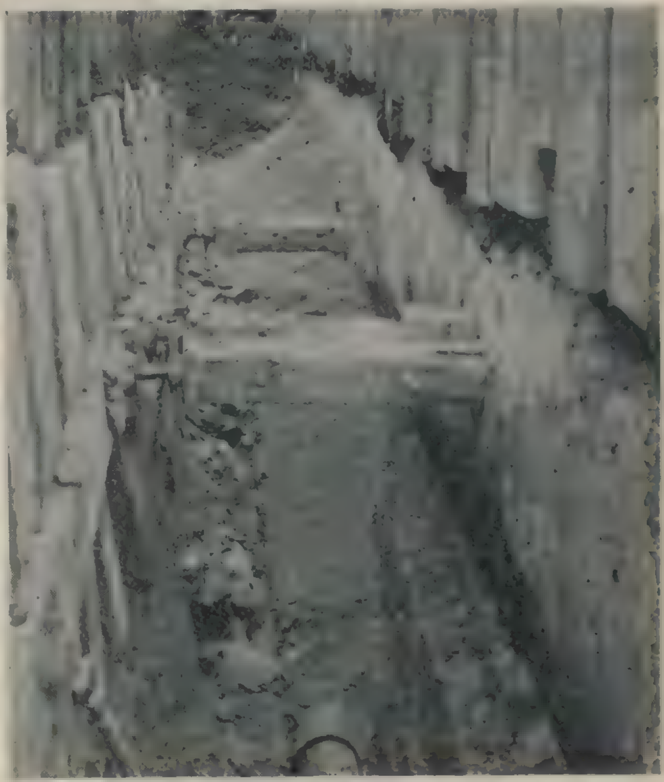


Fig. 4—View showing nature of trench, tile pipe and gravel drain, and portion of aqueduct where disintegration is found.

## Robert Stewart, Ltd., Handling Orders in Spite of Fire in Plant at Guelph

Robert Stewart Limited, Guelph, Ont., who were reported as having suffered from fire loss a short while ago state that they have completed negotiations for a large plant for manufacturing purposes and large and roomy offices and that they will be in a position to take care of any and all orders. Material recently advertised in the Contract Record will be shipped promptly.

# Construction Developments During Month of July

## Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Comparison of Contracts Awarded and Analysis of Contemplated Construction

### *Comparative Statement of Contracts Awarded in Canada*

| | Ontario | Quebec | Maritime | Western | Total |
|---|---|---|---|---|---|
| July, 1921 | $ 7,656,000 | $ 6,106,800 | $ 735,200 | $ 3,243,400 | $17,741,400 |
| July, 1920 | 11,115,600 | 5,229,200 | 2,257,300 | 5,656,200 | 24,258,300 |
| July, 1919 | 10,266,700 | 3,566,300 | 3,458,700 | 4,529,900 | 21,821,600 |
| July, 1918 | 4,085,100 | 1,809,900 | 4,982,400 | 1,193,000 | 12,070,400 |
| 7 months, 1921 | $55,672,500 | $37,865,900 | $ 4,759,000 | $31,207,500 | $129,504,900 |
| 7 months, 1920 | 74,047,000 | 36,053,700 | 13,875,200 | 45,019,500 | 168,995,400 |
| 7 months, 1919 | 46,569,700 | 28,398,200 | 9,693,300 | 15,214,600 | 99,732,900 |
| 7 months, 1918 | 17,561,300 | 16,597,600 | 14,279,900 | 8,472,300 | 56,911,200 |

| | Residential | Business | Industrial | Engineering | Total |
|---|---|---|---|---|---|
| July, 1921 | $ 6,736,300 | $ 6,130,000 | $ 639,000 | $ 4,236,100 | $17,741,400 |
| July, 1920 | 5,301,800 | 11,017,800 | 3,597,000 | 4,341,700 | 24,258,300 |
| July, 1919 | 6,797,800 | 7,687,300 | 4,118,000 | 3,218,500 | 21,821,600 |
| July, 1918 | 1,853,100 | 2,850,800 | 6,452,500 | 914,000 | 12,070,400 |
| 7 months, 1921 | $43,462,200 | $53,312,000 | $ 4,430,000 | $28,300,700 | $129,504,900 |
| 7 months, 1920 | 37,640,400 | 60,046,400 | 45,280,100 | 26,028,500 | 168,995,400 |
| 7 months, 1919 | 24,215,300 | 30,387,000 | 27,542,300 | 17,588,300 | 99,732,900 |
| 7 months, 1918 | 8,115,800 | 14,266,800 | 28,327,600 | 6,201,000 | 56,911,200 |

### *Details of Contracts Awarded During July*

| | Ontario | | Quebec | | New Brunswick | | Nova Scotia | | P.E. Island | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 1 | $ 4,000 | 11 | $ 329,000 | .... | ........ | .... | ........ | .... | ........ |
| Churches | 2 | 27,000 | 6 | 595,000 | .... | ........ | .... | ........ | .... | ........ |
| Factories | 4 | 75,000 | 9 | 556,500 | .... | ........ | .... | ........ | .... | ........ |
| Garages, Public | 16 | 93,300 | 24 | 83,900 | .... | ........ | .... | ........ | .... | ........ |
| Hospitals | 6 | 596,500 | .... | ........ | 1 | $ 10,000 | .... | ........ | 1 | $ 40,000 |
| Hotels and Clubs | 4 | 96,000 | 4 | 565,000 | 1 | 10,000 | 1 | $ 8,000 | .... | ........ |
| Office Buildings | 8 | 182,500 | 6 | 305,500 | 1 | 75,000 | .... | ........ | .... | ........ |
| Public Buildings | .... | ........ | 1 | 5,000 | .... | ........ | .... | ........ | .... | ........ |
| Residences | 929 | 3,929,500 | 187 | 1,068,700 | 19 | 110,600 | 9 | 46,000 | 7 | 40,000 |
| Schools | 15 | 786,200 | 9 | 472,000 | 1 | 16,500 | 1 | 5,000 | .... | ........ |
| Stores | 68 | 514,000 | 26 | 145,200 | 1 | 3,400 | 1 | 12,000 | .... | ........ |
| Theatres | 1 | 15,000 | 3 | 107,000 | .... | ........ | .... | ........ | .... | ........ |
| Warehouses | 3 | 13,500 | 2 | 8,300 | 1 | 6,000 | .... | ........ | .... | ........ |
| Total Buildings | 1057 | $6,332,500 | 288 | $4,241,100 | 25 | $ 231,500 | 12 | $ 71,000 | 8 | $ 80,000 |
| Bridges | 7 | $ 45,900 | 9 | $ 160,600 | 3 | $ 21,800 | .... | ........ | .... | ........ |
| Dams and Wharves | 2 | 47,400 | .... | ........ | .... | ........ | .... | ........ | .... | ........ |
| Sewers & Watermains | 12 | 96,200 | 15 | 357,900 | 1 | 5,000 | .... | ........ | .... | ........ |
| Roads and Streets | 28 | 1,114,000 | 40 | 1,055,300 | 2 | 40,900 | 8 | $ 285,000 | .... | ........ |
| General Engineering | 1 | 20,000 | 3 | 291,900 | .... | ........ | .... | ........ | .... | ........ |
| Grand Total | 1107 | $7,656,000 | 355 | $6,106,800 | 31 | $ 299,200 | 20 | $ 356,000 | 8 | $ 80,000 |

| | British Columbia | | Alberta | | Saskatchewan | | Manitoba | | Dominion | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 1 | $ 15,000 | .... | ........ | .... | ........ | .... | ........ | 13 | $ 348,000 |
| Churches | .... | ........ | 2 | $ 14,300 | 1 | $ 15,000 | .... | ........ | 11 | 651,300 |
| Factories | 2 | 7,500 | .... | ........ | .... | ........ | .... | ........ | 15 | 639,000 |
| Garages, Public | .... | ........ | 3 | 16,500 | 6 | 42,700 | 3 | $ 12,000 | 52 | 248,400 |
| Hospitals | 1 | 6,000 | .... | ........ | 1 | 43,000 | .... | ........ | 10 | 695,500 |
| Hotels and Clubs | 1 | 4,500 | 2 | 5,000 | 1 | 5,000 | .... | ........ | 14 | 693,500 |
| Office Buildings | 1 | 45,500 | 5 | 34,600 | .... | ........ | 3 | 21,500 | 24 | 664,600 |
| Public Buildings | 1 | 6,000 | .... | ........ | 1 | 5,000 | 2 | 18,700 | 5 | 34,700 |
| Residences | 125 | 522,100 | 26 | 74,100 | 32 | 141,700 | 110 | 455,600 | 1444 | 6,388,300 |
| Schools | 10 | 160,600 | 6 | 52,000 | 20 | 282,600 | 4 | 94,100 | 66 | 1,869,000 |
| Stores | 4 | 19,700 | 9 | 39,500 | 3 | 16,500 | 10 | 164,400 | 122 | 914,700 |
| Theatres | 1 | 2,500 | .... | ........ | .... | ........ | 1 | 5,000 | 6 | 129,500 |
| Warehouses | 4 | 98,000 | .... | ........ | 1 | 4,000 | 3 | 99,000 | 14 | 228,800 |
| Total Buildings | 151 | $ 887,400 | 53 | $ 236,000 | 66 | $ 555,500 | 136 | $ 870,300 | 1796 | $13,505,300 |

| | British Columbia | | Alberta | | Saskatchewan | | Manitoba | | Dominion | |
|---|---|---|---|---|---|---|---|---|---|---|
| Bridges | .... | ............... | 3 | $ 69,500 | 1 | $ 6,500 | 3 | $ 20,000 | 26 | $ 324,300 |
| Dams and Wharves | 3 | $ 23,000 | .... | ............... | .... | ............... | .... | ............... | 5 | 70,400 |
| Sewers and Watermains | .... | ............... | .... | ............... | .... | ............... | 4 | 108,000 | 32 | 567,100 |
| Roads and Streets | 2 | 42,000 | .... | ............... | 10 | 243,300 | 6 | 62,700 | 96 | 2,843,200 |
| General Engineering | 1 | 34,400 | .... | ............... | 3 | 74,100 | 1 | 10,700 | 9 | 431,100 |
| Grand Total | 157 | $ 986,800 | 56 | $ 305,500 | 80 | $ 879,400 | 150 | $1,071,700 | 1964 | $17,741,400 |

## *Contemplated New Construction Work in Canada for July*

| | Ontario | | Quebec | | Maritime | | Western | | Dominion | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 1 | $ 25,000 | 3 | $ 150,500 | .... | ............... | 1 | $ 8,500 | 5 | $ 184,000 |
| Churches | 3 | 175,000 | 5 | 217,000 | .... | ............... | 4 | 77,000 | 12 | 469,000 |
| Factories | 7 | 335,000 | 4 | 130,000 | .... | ............... | 2 | 200,000 | 13 | 665,000 |
| Public Garages | 12 | 103,000 | 4 | 127,000 | 2 | $ 35,000 | 1 | 10,000 | 19 | 275,000 |
| Hospitals | 2 | 42,000 | 1 | 30,000 | 2 | 180,000 | 3 | 316,000 | 8 | 568,000 |
| Hotels and Clubs | 3 | 765,000 | 3 | 53,000 | 2 | 100,000 | 3 | 119,000 | 11 | 1,037,000 |
| Office Buildings | 6 | 155,000 | 3 | 135,000 | 2 | 40,000 | 5 | 112,000 | 16 | 442,000 |
| Public Buildings | 4 | 32,000 | 1 | 25,000 | 1 | 20,000 | 8 | 189,500 | 14 | 266,500 |
| Residences | 63 | 556,500 | 175 | 1,424,000 | 5 | 37,000 | 43 | 246,900 | 286 | 2,264,400 |
| Schools | 15 | 971,000 | 10 | 229,000 | 3 | 20,000 | 52 | 852,800 | 80 | 2,072,800 |
| Stores | 8 | 272,000 | 4 | 265,000 | 2 | 16,000 | 7 | 215,500 | 21 | 768,500 |
| Theatres | .... | ............... | .... | ............... | 1 | 250,000 | .... | ............... | 1 | 250,000 |
| Warehouses | 2 | 15,000 | .... | ............... | 1 | 10,000 | 1 | 10,000 | 4 | 35,000 |
| Total Buildings | 126 | $3,446,500 | 213 | $2,785,500 | 21 | $ 708,000 | 130 | $2,357,200 | 490 | $9.297,200 |
| Bridges | 15 | $ 201,000 | 7 | $ 187,000 | 1 | $ 10,000 | 19 | $ 161,000 | 42 | $ 559,000 |
| Dams and Wharves | 1 | 6,000 | 1 | 50,000 | 1 | 15,000 | 1 | 2,200 | 4 | 73,200 |
| Sewers & Watermains | 19 | 258,000 | 14 | 585,000 | 1 | 20,000 | 6 | 125,000 | 40 | 988,000 |
| Roads and Streets | 32 | 1,400,000 | 30 | 825,000 | 15 | 308,000 | 20 | 644,500 | 97 | 3,177,500 |
| General Engineering | 7 | 2,170,000 | 4 | 197,000 | 1 | 15,000 | 5 | 77,500 | 17 | 2,459,500 |
| Grand Total | 200 | $7,481,500 | 269 | $4,629,500 | 40 | $1,076,000 | 181 | $3,367,400 | 690 | $16,554,400 |

# Progress in the Construction of the Government Dry-dock at Esquimalt

By J. B. Holdcroft, Consulting Engineer, Victoria, B. C.

With the advent of summer weather, rapid progress has been made on the construction of the Dominion Government's new 1.100-ft. dry-dock at Esquimalt, B.C. The contractors have completed the grading of a spur track to connect with the main line of the Esquimalt and Nanaimo Railway, and track material is on the ground ready for laying, which will be proceeded with at once.

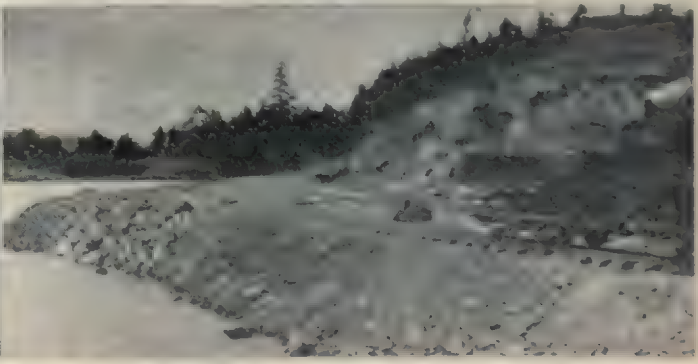
Dredging for the landing wharf is well in hand, and has been completed to bed-rock, a depth of 50 to 60 feet below low water mark, and the construction of the inner cofferdam is approaching completion. It is expected that this cofferdam will be entirely finished by about the 10th of August, and that pumping out will then commence, following which the excavation for the dock itself will commence.

### Work to Proceed in Two Sections

The work is to be handled in two sections, requiring an inner and an outer cofferdam, this arrangement on a work of such magnitude being advisable from considerations of safety as well as for construction reasons. No work has yet been commenced on the outer cofferdam, as it is the intention to compete the inner one, and have pumping and excavation under way during the construction of the outer dam.

The contractors have an excellent equipment of

Esquimalt dry-dock: Shovel working on grade for roadway on inner side of dock. Shore end of inner cofferdam to left.



Grading for spur to Esquimalt & Nanaimo Railway machinery for the heavy work in hand, incuding two steam shovels, two compressors and six drills, all of which are at present engaged on the grading of the permanent roadway on the inner side of the dock.

Electric power has been brought in for the compressors, and will also be used for the centrifugal pumps which are already on the ground ready to start on the unwatering as soon as the cofferdam is completed. Current is supplied by the Vancouver Island Power Co., from their hydro-electric station at Jordan River, nearly forty miles away, and a high tension transmission line has been brought in to the site of the work, where a transformer station has been located, stepping down the current from 12,000 volts to 2,300 volts, at which it is being used for the motors.

The work is being rushed as much as possible, and is being handled in three shifts so that it is proceeding practically continuously. About 250 men are now employed, and the crews will be materially strengthened as the work opens up, until a maximum of probably 600 men are engaged.

The construction of the substructure cribs for the landing wharf is under way at the yards of Yarrow's Ltd., just across the harbour from the dry-dock site, and it is expected to launch these cribs within the next few days.

# Underwriters Recommend Changes in Toronto's Water Facilities

After a thorough review o fthe city of Toronto's water works system and fire department, the Canadian Fire Underwriters' Association, in its report, recommends:

A third water intake; extension of filtration plant from forty-eight milliion to ninety-five million gallons, or that the propesed twenty-million-gallon pure water reservoir be undertaken without delay; that oil immersed transformers in pumping stations be installed in separate fireproof rooms or located outside stations; that adequate internal protection be provided for the pumping station n connection wth the slow sand filtration plant; that for the external protection of both plants a ring main be laid below frost line, encircling the plant and supplying hydrants placed 25 to 30 feet from the buildings, and that hose houses containing hose and play pipes be provided at hydrants.

### Pumping Stations.

That additional boilers be installed at the main pumping station, so that it may be possible to run all steam pumps at the same time; that additional internal protection in the form of chemical fire extinguishers and pails of sand be provided at the station; that the hose at this station be placed on a reel and kept in a detached reel house; and that a fire alarm box be installed at the staion: that the 13,200 volt arresers, switch gear and all oil immersed transformers be removed and placed in a detached fireproof sub-station; and that 13,200 volt overhead conductors be removed from he station; that at the high level station oil immersed transformers be installed in a fireproof room.

That chemical fire extinguishers and pails of sand be provided at the high level, Beech avenue and East Toronto pumping stations; and at the Riverdale pumping station additional pumping capacity with independent power shall be installed so that the evailable capacity shall in no event be reduced to less than the present amount, namely, 100,000,000 gallons per 24 hours; that at the Beech avenue pumping station a second and independent source of power be provided for operating pumps; that oil immersed transformers now in this building be installed in a separate fireproof room, or be located outside the building.

That at the East Toronto pumping station, an additional boiler be installed so as to make it possible to run the larger pump and the steam generating unit at he same time with one boiler spare; that storage capacity be increased to 1,000,000 gallons, and that the method of cutting in the emergency supply of electric current for pumping be re-aranged so that an operator in a substation could interconnect with the two systems without the services of linemen.

### Mains.

That at least one of the 36 inch mains, proposed by the department, from the main pumping station to Front street be laid; that the 36-in. from Front st. to Dupont st. be laid; that the two 36-inch mains to the reservoir be continued into the same; and that the reservoir be divided into two sections; that a main be laid on Queen st. east, so as to deliver at a rate of not less than 1,800,000 imperial gallons per 24 hours for fire purposes when all other draughts are in full flow, with a pressure at hydrants not less than 80 lbs. and also a larger main on King st. west, so that 3,000,000 gallons per 24 hours may be available for fire purposes under similar conditions; that the 12-inch main on Dundas st. at St. Helen's ave. be continued west across the railway bridges to connect wth the 12-in at Sorauren ave.; and that a 12-inch be laid on Howard Park ave. connecting the 12-inch on Dundas St. with the 12-inch on Roncesvalles ave.

That the contemplated duplicate main to the North Toronto district be laid as soon as possible; that additional secondary feeders be laid where required, so that their distance apart shall not exceed 3,000 feet; that where the gridiron system is composed of 6-inch mains, additional mains be laid so that the distance between them shall not exceed 600 feet; and that where the length of block is too great to allow this or where poor gridironing seems likely to prevail for sme time, mains not less than eight inches diameter be laid; that the works of replacing or reinforcing mains less than six inches diameter by larger mains be continued; and that dead ends be put in circulation. The high pressure system be extended, and additional pumping capacity installed, as proposed by the department, and particlarly that the proposed duplicate supply mains be laid as early as possible.

### FIRE DEPARTMENT SUGGESTIONS.

That the retiral age be fixed at 62 unless members are unusually efficient at that time; that ladder companies be maintained so that the least number of men on duty shall be eight in or near districts in which there are high values (with six men for hose companies) and six in other districts; that a chemical truck be provided for No. 20 Station, Toronto Junction, and a triple combination hose truck, with chemical engine and hose pump, for East Toronto; that ladder companies be established in the northwestern and eastern part of the city, and Ladder truck for No. 8. Station, College st.; that proper arrangements be made for response by men off-duty to second or subsequent alarms, or that the least number of men on duty be increased by 25 per cent.

That the regulations appyling to the parking of automobiles including the regulation prohibiting the obstruction of hydrants, be more strictly enforced, and that the parking of automobiles be not allowed in the centre of streets in the congested values area..

### FIRE ALARM SYSTEM.

That additional equipment to accommodate 30 box circuits in all be provided; that an emergency service from the Toronto & Niagara Power Company be provided for charging batteries; that chemical extinguishers and pails of sand be provided on all floors at headquarters; that all stations be equiped with duplicate alarm circuits, that all boxes in the congested values area be installed on metal standards, that boxes and indicating bands on poles be painted a bright red, and red lights be installed directly over all boxes; that box circuits be arranged so that not more than 20 boxes are connected to a single circuit; that all box circuits and cables within the congested values area and mercantile sections be underground, preferably in ducts having only low tension conductors; that overhead circuits be removed from poles carrying high tension wires.

That each fire station have a direct line to alarm headquarters switchboard; that telephone alarms received from the congested values districts be transmitted from headquarters as box alarms, after notifying the nearest station.

### BUILDING DEPARTMENT.

That shingle roofs be permitted in Limit "A"; that the regulation in respect of protection of vertical openings be made more explicit in requiring all vertical openings in fireproof buildings be protected; that in sprinklered buildings all stairways be required to be protected; the supporting of any brick chimney on woodwork be prohibited, and that parging the insides of flues with mortar be not allowed. That suitable reguluations governing storage of matches and fireworks be adopted.

### ELECTRICITY.

That all overhead wires of the signal companies and the electric light systems be placed underground in the congested values area and in minor mercantile districts; that municipal or provincial ordinances governing the erection and maintenance of overhead wires of all classes be enacted; that a complete reinspection of old wiring instalatioins in buildings in the congested values area and in minor mercantile districts, be made, defects corrected and all wifing in these sections subsequently reinspected at frequent intervals; that new wiring nstallations in buildings in the congested values area be installed in iron conduit or metal race-ways.

# Fine Theatre in Victoria Nearing Completion

## The "Capitol" a Splendid Addition to the Many Handsome Playhouses of the West

This fine addition to the list of playhouses at Victoria, B. C., now nearing completion, is being erected by the Paramount Victoria Theatres, Ltd., and is one of a chain of motion picture houses which the Paramount interests have built in Canadian towns from Winnipeg west. In each case, local capital is interested as far as possible; and the control is largely localized, also. The Building has been erected on the cost-plus percentage plan, by Luney Bros, Ltd., of Victoria, general contractors, the plans having been prepared by the Famous Players (Can.) Corporation's own architect.

The Capitol theatre, Victoria, B. C.

# Cold Air Faces Made of Hardwood

Mr. E. R. Machon, 53 Boon Ave., Toronto, manufacturer of hardwood cold air faces, advises that his product—which he started manufacturing over six years ago—is meeting with a growing demand. The faces take the place of cast iron faces, and among the advantages claimed are that the loading strength of oak faces is greater than that of cast iron; that they may be finished to match the floors on which they are laid; that they will stand heat from steam radiators

without either warping or shrinking, and that having a much lower heat conductivity than iron they do not give one the extreme sensations of heat and cold when they are touched. These faces are also used over ventilating outlets. They are made in sizes varving from 10 in. by 14 in. to 20 in. by 30 in. for floors, and in wall faces 6 in. by 30 in. and 8 in. by 30 in. These faces are made 1-⅜ in. thick, which allows them to rest on the joists and thus set flush with the floor. They are made of the best quartered oak. The air capacity is 60% of the face. The accompanying illustration gives an idea of the attractive appearance of these hardwood faces.

## National Slag Products, Ltd., to Make New Type of Building Partition

The National Slag Products, Limited, was incorporated recently under the Companies' Act of the Dominion of Canada, for the purpose of manufacturing building tile, bricks, roofing slabs, floor slabs, field grain tile, fence posts, door and window lintels, door and window blocks, etc. After an exhaustive research, a special process has been evolved whereby it is claimed, superior products of this nature can be manufactured at a lower cost than products at present used for the same purpose.

Engineers and contractors have been experimenting with various grades of tile that would be cheap in production, easily manufactured in standard sizes and possessing all the required elements of strength, lightness, fireproof and insulating qualities, etc. Mr. E. J. Robertson, engineer and plant operator, has produced a tile that has been enorsed by engineers, architects and contractors in Canada and in the United States. Their reports show that the tile possesses the following special qualities—a weight of only 62 pound per cubic foot; fireproofness, waterproofness and high insulating qualities; amle crushing strength; less labor and mortar required in erecting a wall with National Slag Products tile; tile can be easily supplied in all standard sizes; will take a nail readily; can be easly sawn to any size required; can be laid either vertically or horizontally in wall or partition. A careful estimate of manufacturing costs shows that this tile can be sold at a cheaer rice than any tile of its nature on the market. The pro ducts of the company will be used in dwellings, factories, office buildings, hotels, etc., where construction calls for materials fulfilling the above conditions.

### Location of Plant.

A site has been secured at Hamilton, Ontario, on which a plant of the most modern description will be erected. Contracts have been made for machinery and equipment at favourable prices. The raw material needed will be purchased at contract prices from the Steel Company of Canada, Limited, whose plant is only a short distance away. The site consists of 2½ acres on Gage Avenue in the city of Hamilton, and faces the main line of the Canadian National Railway, from which sidings will be run into the plant. Shipping facilities will thus be ideal, water transportation can be readily arranged to all points on the Great Lakes, which will enable the company to distribute its products to points where active demand exists. The plant will have an initial minimum capacity ot 6,000 5" x 8" x 12" tiles per day and can be readily extended to manufacture any number needed. Other prducts may be manufactured in conjuncion with the tile plant.

The directors of the company are: William H. Yates, president, president W. H. Yates Construction Company,Hamilton; David Dick, vice-president, president National Sand & Material Company,Welland; J. P. Anglin, Anglin-Norcross, Limited, Montreal; Hon. G. D. Robertson, Minister of Labor, Ottawa; H. J. Daly, President Home Bank of Canada; W. R. Fleming, managing director Canadian Debentures Corporation; Gordon Hutton, president Architects Association of Hamilton; E. J. Robertson, manager and secretary-treasurer, Hamilton.

Mr. E. J. Robertson is a practical and experienced plant operator. He has been in charge of a number of important government contracts, and has lately been superintendent of concrete construction on the Welland canal. The works superintendent is Mr. James Owens, who possesses over eighteen years' practical experience as a successful superintendent He has lately been superintendent of construction on the Chippeawa canal.

### Process of Manufacture.

The granulated slag, to be employed in the new material which the National Slag Products, Ltd, will produce, is a by-product of the blast furnaces of the Steel Co., of Canada, and hitherto having no market value has been dumped in the Bay at Hamilton for a number of years The slag is obtained by a very simple granulating process. As the molten slag runs from the furnace it is carried through one trough, and drops nto a second trough. As the slag drops from the first trough to the second, a stream of cold water is turned iinto the flow of molten slag, this process exploding or granulating the slag into a material similar to sand. This new material is full of voids, and weighs less than half as much sand.

After the granulation process takes place the slag is run from the end of the second trough through into railway cars, ready for shipment. It is then mixed with cement and compressed under 40 tons pressure into all standard sizes of building tiles,

As the analysis of the slag shows that it contains over 20% of lime, it is not necessary to use as much cement as would be necessary with sand or gravel as the aggregate.

## Fire Resistance of Creosoted Wood Blocks

Creosoted wood blocks when exposed to fire on their wearing surface only are fire resistant to a marked degree. The Railway Age Gazette, December 17, 1915, quotes a report of the burning of the Philadelphia & Reading Pier No 36 at South Wharves, October, 1914, as follows: "This fire was so hot that a large portion of structural steel was fused, the whole pier shed was destroyed and the greater portion of the burnt wreckage was thrown on the wood block floor. After the removal of the debris, it was found that the wood blocks, which had been subjected directly to the flames, were only charred ⅛ to ¼ inch, but where the fused structural steel had come into contact with the wood blocks, they were charred from ¾ inch to 1 inch deep."

# Experiments on Sewage Disposal at Sheffield, Eng.

## Paper Read Before the Institution of Municipal and County Engineers Outlines the Investigational Work on Aeration Methods of Sewage Purification Carried Out in England

**By John Haworth, F.I.C., F.C.S., Manager, and F. W. Hodgkinson, Resident Engineer, Sewage Disposal Works, City of Sheffield.**

During the year 1912 a series of experiments was initiated at the Sheffield, Eng., sewage disposal works in order to ascertain what further treatment was necessary to render the effluents from the existing primary contact beds satisfactory to the Rivers Authority. The experiments were laid out in specially constructed tanks on the following lines: (1) Filtration through shallow filters; (2) rapid filtration through percolating filters; (3) aeration by blowing air through perforated pipes; (4) aeration by trickling through orifices, and (5) precipitation and chlorination. It is not intended to describe these experiments more fully in this paper, but reference is made to them as the results indicated that aeration in some form would have sufficed for the purpose then required.

During the process of this work a paper was published by Ardern and Lockett, describing certain experiments carried out in Manchester. Their investigations showed that if a liquid containing organic solids, such as deposits from sewage, was submitted to aeration for a sufficient period—namely, until a high degree of oxidation occurred—the sludge then contained a large number of organisms of varying types and was capable of purifying sewage brought into contact with it in a few hours, provided that air in a finely-divided state was continuously blown through the mixture of sludge and sewage. The bacterial sludge or humus thus produced was called "activated sludge."

In principle this method of operation is a natural development of the existing modes of bacteriological treatment of sewage. In the treatment of sewage on land the sewage is brought into contact with organisms present in the soil intensified by the concentration of similar organisms in immense numbers on the surfaces of solid media, such as the slag, stone, slate, etc., composing the contact bed, the percolating filter, and the Dibdin slate bed. In all these cases the sewage is brought into contact with the organisms in the presence of oxygen of the air taken into solution on the wetted surfaces. Similar purification also obtains in the self-purification of rivers, in which the organisms, in the presence of dissolved oxygen, oxidize the putrescible organic matters.

The great value of the investigations of Ardern and Lockett lies in the demonstration that sewage may be purified by bringing it into direct contact with the bacterial humus or sludge, without the necessity of providing solid surfaces to carry the humus, and that contact beds and percolating filters may thus be dispensed with, and the operations of sewage disposal be reduced to treatment in tanks.

In view of this development some of the experimental tanks previously referred to, provided either with perforated pipes or porous diffusers connected to the air compressor, were utilized, and a quantity of sludge was matured for experiment. Settled sewage and effluents from primary contact beds were submitted to treatment, with promising results so far as purification was concerned. The chief difficulties encountered were: (1) Interference of trade wastes of an acid character, and (2) choking of the perforated pipes and diffusers by dirt from the atmosphere and the sewage, and by organic growths.

It appeared possible to overcome the former difficulty by neutralization of the discharges of trade wastes or by dilution, but the latter difficulty was more serious. The small orifice has always been a bugbear in sewage disposal plants, whether found on the fine screen, the sprinkler arm, the fine grain filter, or aeration appliances. To increase the size of the orifices in the perforated pipes or diffusers sufficiently to avoid trouble appeared to necessitate the use of more air than could be afforded to make the process economical and practicable. It was, therefore, concluded that unless some other means could be devised for forcing finely-divided air into the sewage, which at that time was considered essential, the process was impracticable so far as Sheffield sewage was concerned. With some degree of success an attempt was made to devise methods of inducing air into the liquid not dependent on small orifices.

The whole position was then carefully reviewed in the light of the experience gained, and further experiments were devised having chiefly in view the following considerations:

(1) That the air blown into the sewage performs two functions, viz.: (a) the supply of oxygen in solution to maintain the biological life, and (b) the agitation of the sludge with the liquid, the greater proportion of the air being used for the latter purpose.

(2) That these functions might possibly be separated—the agitation might be accomplished by direct mechanical appliances and the smaller amount of air in solution be supplied by other means.

(3) That in the case of percolating filters, contact beds, and river self-purification, ample oxygen is taken into solution from the atmosphere on the wetted surfaces to support the biological life necessary to purify the sewage efficiently, and in these cases finely-divided air is absent. Only dissolved oxygen is of value in supporting biological life. Therefore, if sufficient change of surface could be economically produced in the liquid the necessary solution of oxygen might also be obtained in this case.

(4) That the surfaces of bubbles are not specially

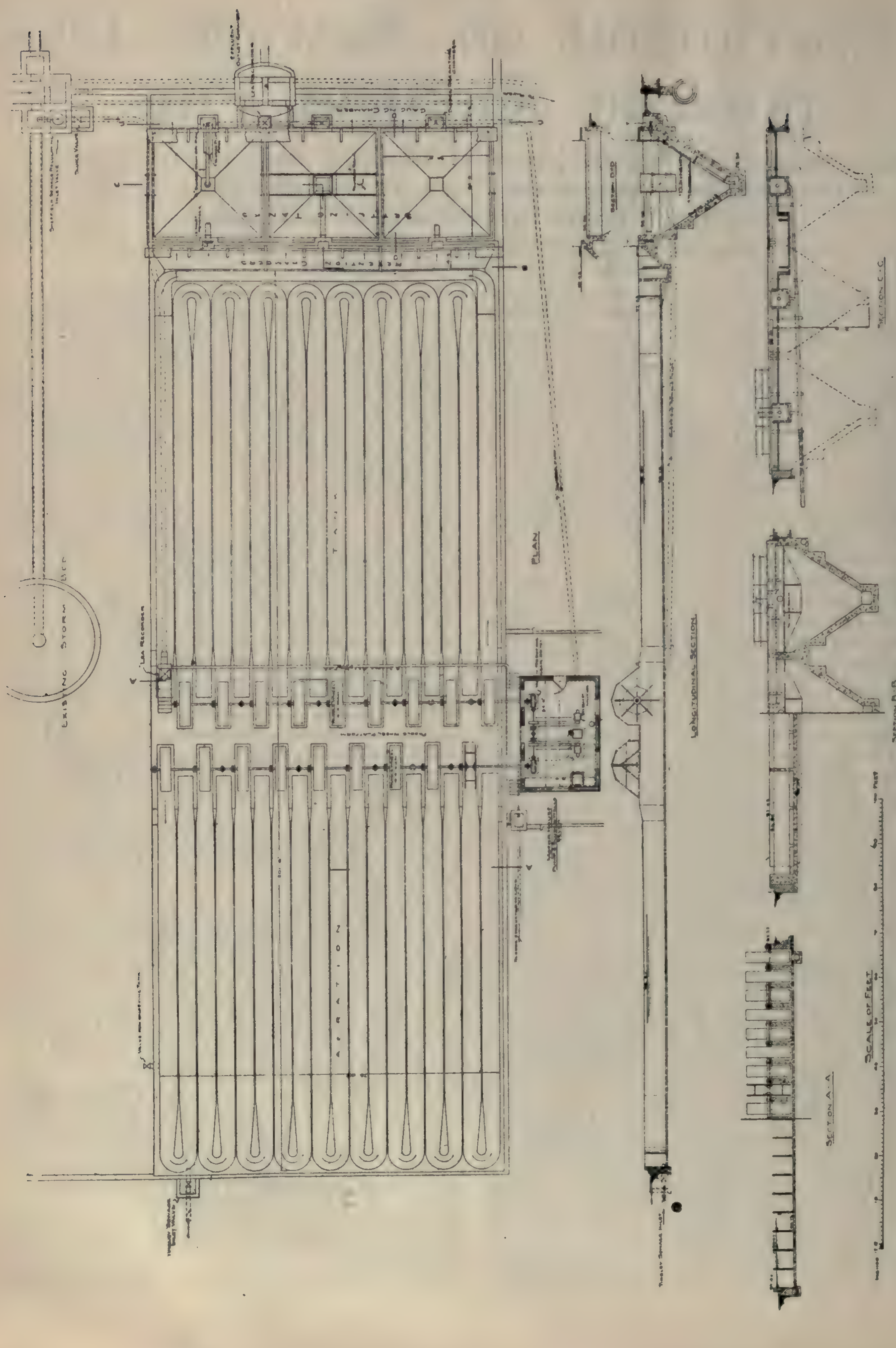


Fig. 1. Bio-aeration plant, Sheffield sewage disposal works

suited to permit solution of oxygen from the bubble itself, but that the great change of surface produced at the top of the liquid by rising bubbles probably accounts for a large amount of the solution of ogygen obtained. If a gas, such as nitrogen, is bubbled through water free from air, exposed to the atmosphere solution of oxygen takes place.

(5) That it is undesirable to have essential parts of a sewage plant immersed in the liquid and not easily accessible or visible when in operation.

### Purification Without the Use of Aerator.

Early in 1916 a tank of 800 gallons capacity was fitted with a paddle stirrer and with an apparatus for inducing air mechanically. After this tank had been in use for some time it was found that by suitably regulating the revolutions of the paddle, purification could be obtained satisfactorily to the extent of at least three fillings of the tank per day without the use of the aerator. The tank has been operated during the last five years in this manner.

The experiments were then extended on a larger scale, and two tanks of a different design were brought into operation and have worked regularly for about two and a half years. These tanks are 30 ft. by 14 ft. by 4 ft. deep, with level floors. Division walls were constructed to form a continuous channel, approximately 3 ft. 3 in. wide, along which the sewage can circulate and return to an agitator placed at one end of each tank. The agitator consists of two vertical pistons of the Root's blower type. On rotating the agitators, the sewage is circulated at a velocity sufficient to prevent settlement of the sludge. A velocity of 1½ ft. per second has been found ample to accomplish this result. A mechanical aerator was fixed in one of the tanks in case additional air was required, but it has been found unnecessary. By means of the agitators and the special construction of the tanks constant change of surface occurs.

On starting the tanks humus washed from material taken from a contact bed was put in to a depth of about 6 in. and then they were filled with sewage. After ten days' agitation the sludge was completely coagulated and flocculent, and found to be sufficiently mature to allow the experiment to proceed. The tanks were then worked on the "fill-and-draw" principle, and have purified sewage continuously, three fillings of each tank per day being dealt with. The liquid treated is an industrial sewage, containing at times a large proportion of iron liquors, soups, etc.; these occasionally have necessitated extended periods of treatment.

The results in respect to purification and power required have been generally satisfactory, but it was evident that accurate and reliable data and definite conclusions respecting questions such as power required, maintenance, and working and capital costs, could not be obtained from a plant treating comparatively small volumes. Therefore, in 1919, in accordance with the instructions of the city council, a large unit was designed and constructed to operate on the continuous-flow system to treat the sewage from the Tinsley district, and with the object of obtaining information and data respecting the application of the process on a large scale. The plant was completed in the latter part of 1920.

### Description of Installation.

The plant is shown in detail on the accompanying drawing, Fig. 1, and consists of aeration tank, three rotation chambers, three settling tanks, gauging chamber and motor-houses.

The aeration tank is 201 ft. 6 in. long, 75 ft. 10½ in. wide and 4 ft. deep below the water surface, and has a capacity of approximately 354,400 gallons. It is divided into eighteen longitudinal channels 4 ft. wide by thin division walls witt a transverse channel 2 ft. 3 in. wide by 6 ft. deep along the end facing the retention chambers. The channels are rounded and connected at their ends so as to form one continuous channel 3,544 ft., or nearly three-quarters of a mile in length. The transverse channel has been made deeper than the longitudinal channels, so as to admit of retention chambers of increased size. The ends of the division walls forming the return of the channels are enlarged in order to strengthen the division walls, and to reduce the eddies in the water flowing round them, and correspondingly the friction head losses, and to produce changing surfaces of the liquid. The floor of the tank is flat, and the channels are therefore rectangular in section. Across the centre of the tanks are arranged eighteen paddle-wheels (referred to later) which agitate and circulate the water. Inlets for the Sheffield and Tinsley sewage are provided as shown, the former being fitted up with a float regulating-valve. The outlet from the tank is over the weir wall running the full length of the transverse channel and forming one side of the retention chambers.

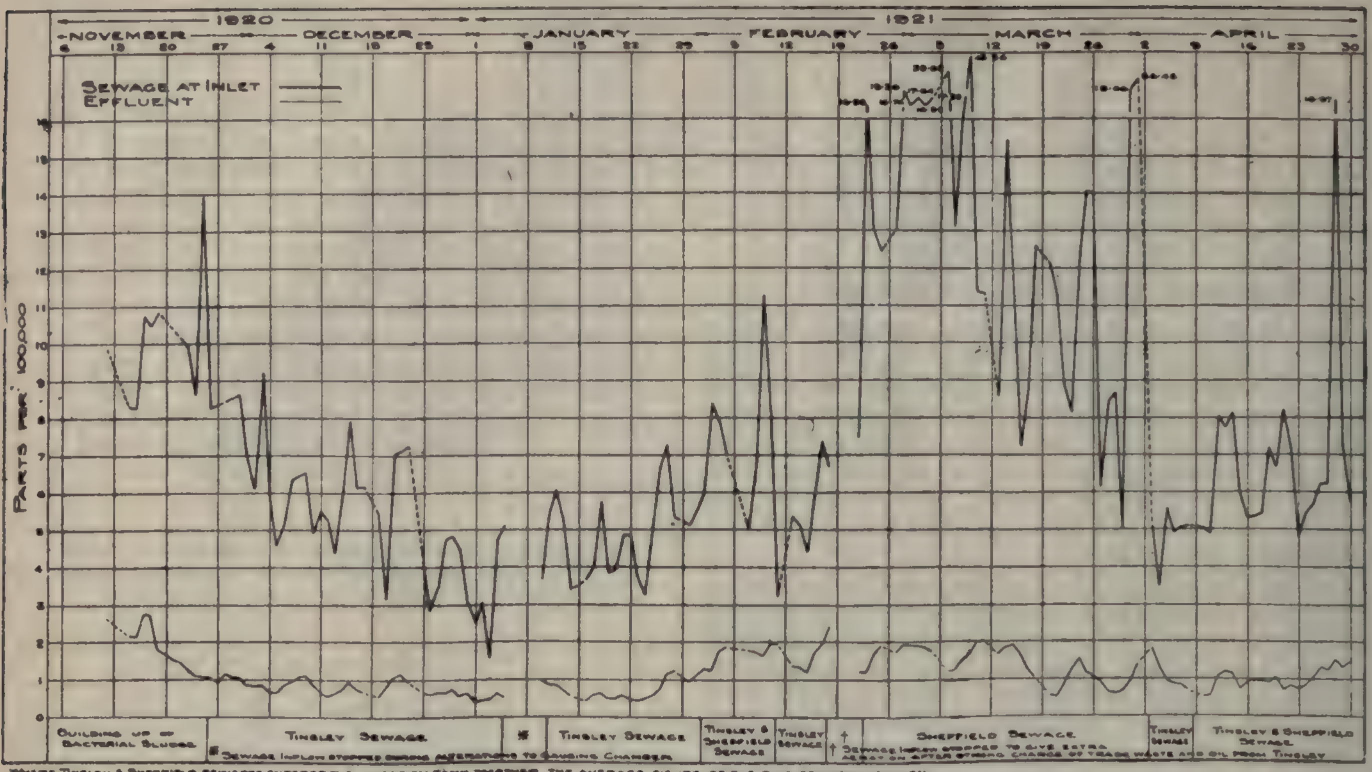
ANALYTICAL RESULTS OF SEWAGE ON ENTERING THE AERATION TANK AND EFFLUENTS LEAVING THE SETTLING TANKS.

| | November 26th, 1920, to January 31st; 1921<br>62 samples | | | | | |
|---|---|---|---|---|---|---|
| | Results expressed in parts per 100,000 | | | | | |
| | Tinsley Sewage | | | Effluents | | |
| | Worst | Best | Average | Worst | Best | Average |
| Suspended solids | [illegible] | 11·00 | 27·23 | Less than | [illegible] | |
| Oxygen absorbed in 4 hours .. | 9·22 | 1·58 | 5·40 | 1·23 | ·39 | ·76 |
| Free and saline ammonia ... .. | 5·16 | 1·06 | 3·38 | 5·70 | ·70 | 3·30 |
| Albuminoid ammonia | 1·62 | ·29 | ·62 | [illegible] | [illegible] | ·14 |
| Nitric nitrogen | — | — | — | ·03 | ·34 | ·16 |
| Dissolved oxygen taken up in 5 days at 65° F. | — | — | — | 2·20 | ·13 | 1·00 |
| | February 22nd, 1921, to April 2nd, 1921<br>35 samples. | | | | | |
| | Sheffield sewage | | | Effluents | | |
| | Worst | Best | Average | Worst | Best | Average |
| Suspended solids | 267·4 | 21·6 | 77·42 | Less than | 3·00 | |
| Oxygen absorbed in 4 hours | 45·56 | [illegible] | 13·93 | 2·02 | ·50 | 1·39 |
| Free and saline ammonia | 9·06 | 3·27 | 5·09 | 5·87 | 3·20 | 4·41 |
| Albuminoid ammonia | 2·57 | ·73 | 1·22 | ·31 | ·12 | ·19 |
| Nitric nitrogen | — | — | — | ·06 | ·20 | ·10 |
| Dissolved oxygen taken up in 5 days at 65° F | — | — | — | 2·17 | ·52 | [illegible] |

Figure 2.

The mechanical operation of the aeration tank consists of creating rapid surface changes of its contents by means of the paddle-wheels which agitate the liquid and circulate it continuously round and round the channels, the rate of outflow from the tank being governed by the rate at which the sewage is let into it.

The retention chambers are triangular in section, the wall adjoining the aeration tank is vertical, and, as



Where Tinsley & Sheffield sewages entered the aeration tank together the average figure of the two sewages is given.

Fig. 3—Oxygen absorbed in four hours

before stated, the liquid enters the chambers by passing over it. The opposite wall is sloping, and at the top of this is formed the weir over which the liquid discharges into the feed channel to the settling tanks. In the bottom of the vertical wall are openings through which any sludge settling in the retention chambers may return to the aeration tank. The chambers are 4 ft. 3 in. wide and 4 ft. 8 in. deep, and correspond in length with the settling tanks.

### Purpose of the Retention Chambers.

The object of the retention chambers is, by the greatly diminished velocity of flow obtained in them, to secure partial settlement of the liquid before it passes to the settling tanks, and so "retain" as much sludge as possible in the aeration tank. This advantage is three-fold—it reduces the amount of sludge to be pumped; less sludge reaches the settling tanks, and thereby their settling capacity is increased, and there is less sludge temporarily out of action. Whether the retention chambers are effective in their working under all conditions it is too early to express any opinion. At low flows the effect is quite apparent, but systematic observations and tests have not yet been made.

The three settling tanks of the Dortmund type, pyramidal in shape, with sides sloping 1 to 1½; they are each 24 ft. square by 21 ft. 6 in. deep, and have a total

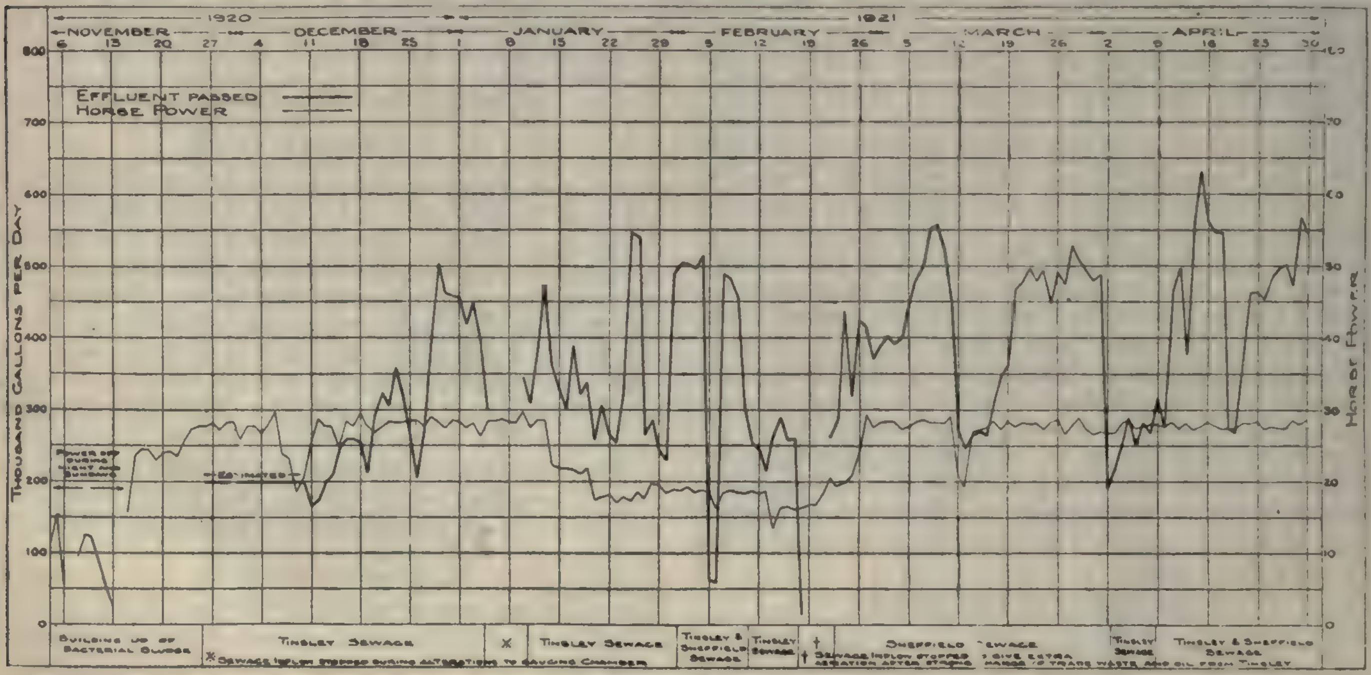


Fig. 4—Effluent passed and horse power.

capacity of 102,600 gallons. The liquid enters each tank by a 12 in. penstock and pipe which connects to a plain vertical bottomless box 4 ft. square inside and submerged 7 ft. of its length in the liquid. The boxes and the ends of the pipes bolted to them are supported centrally in the tank by trussed beams built of light steel angles and flats. The four sides of each tank form the weir over which the effluent passes to the collecting channels, or direct to the gauging chamber, where the flow is registered by a "Lea" recorder. From the chamber the effluent empties into the discharge culvert to the river.

### Path of the Sludge.

The sludge from the settling tanks is raised by hydrostatic pressure through 6 in. pipes into small sludge chambers in which the control valves are fixed. In each of these chambers are also two small pilot pipes fitted with valves, by means of which the attendant is able, at any time, to check the level or amount of sludge in the tanks. From the sludge chambers the sludge gravitates through a stoneware drain to the sludge well below the motor house, whence it is pumped back to the aeration tank, entering the channel farthest from the motor house, where a "Lea" recorder registers the amount of sludge pumped. On the sludge return main and near the motor house there is a bypass valve and chamber through which the surplus sludge is evacuated to the land.

The motor house is 24 ft. long by 16 ft. wide, and contains two 20-b.h.p. motors belt-connected to worm-reduction gears which in turn drive the two shafts on which the paddle-wheels are fixed. The layout is so arranged that each worm gear can be driven independently by its own motor, or the two gears can be coupled together and driven by one motor, the other motor then becoming a stand-by. Each motor is equipped with a liquid starter. It is admitted that the belt drive does not give the most efficient power unit, but it was specially introduced for experimental purposes so that, by varying the size of the belt pulleys, different speeds of the paddle-wheels could be obtained.

Below the motor-house floor are the sludge and pump wells. In the latter two 4 in. centrifugal pumps direct coupled to 7½ b.h.p. motors are installed. These motors are controlled by a float in the sludge well and an automatic relay switch, or by hand. The sludge well has a capacity of 2,500 gallons at invert level of the inlet pipe. The electrical supply is 3-phase alternating current, 50 cycles per second and 440 volts.

Referring to the paddle-wheels, these are 10 ft. diameter by 2 ft. 6 in. wide over all, constructed of light steel angles suitably braced and connected to cast-iron split bosses which are bolted and keyed to the shafts. Each wheel weighs about 7 cwt. There are eight arms to each wheel, and each arm presents a blade surface to the water of 227 sq. in., with a radius of gyration of 3.66 ft. about the paddle-wheel shaft.

At fifteen revolutions per minute of the paddle-wheels a minimum velocity of flow of 1.7 ft. per second is secured in the channels of the aeration tank. Several experiments have been made by increasing the blade area of the wheels and reducing the revolutions per minute, and it was found that at any speed less than thirteen revolutions per minute—whether the blade area was increased or not— a considerable wave effect on the water was produced which caused splashing over the walls at the curved end of the channels. If it be advantageous to secure this effect from the point of obtaining greater aeration—which has yet to be proved—it will be necessary to increase the height of the walls at the channel ends.

With few exceptions—such as the walls of the motor house, which are in brick—the whole of the constructional work has been executed in concrete, complete steel reinforcements only being used in the walking ways and platforms across the tanks. In the thin division walls of the aeration tank, which are 2½ in. thick at the top, tapering to 4½ in. at the base, and approximately 4 ft. 8 in. high, a horizontal ¼ in. round steel bar was introduced about 3 in. below the top of the wall; this was done simply to assist the walls against vertical cracking in the initial setting, and during the

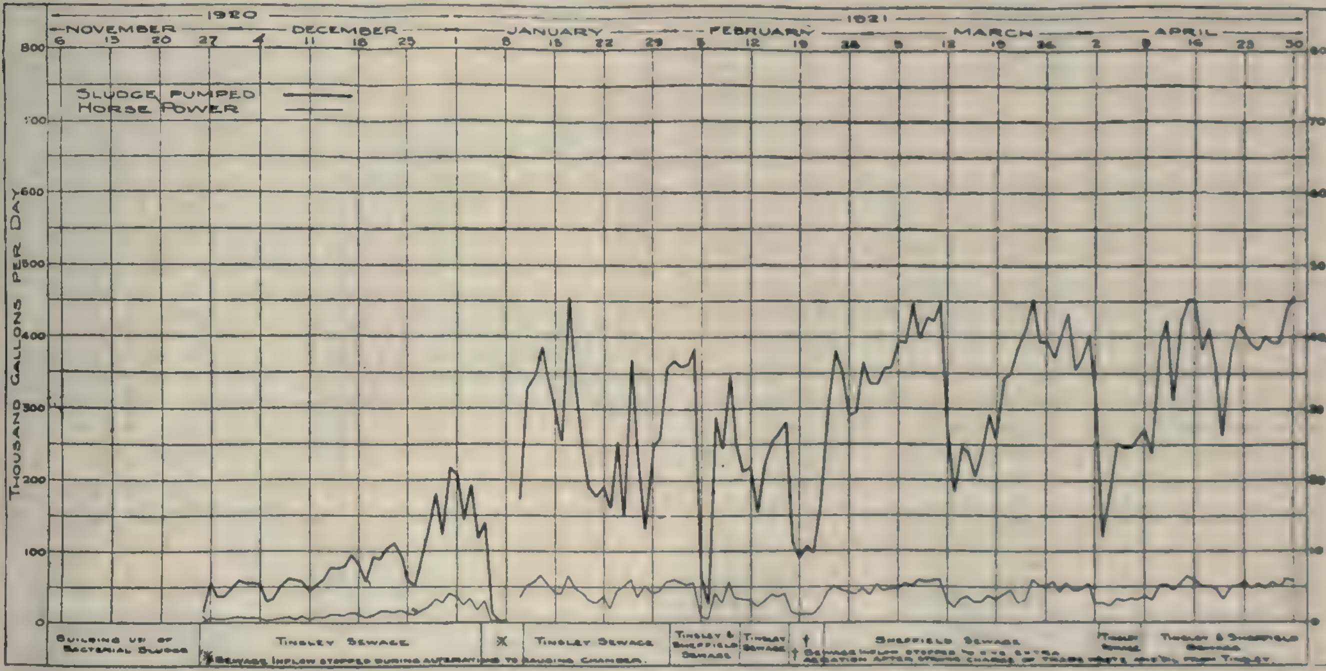


Fig. 5—Sludge pumped and horse power.

period they were exposed to the changing temperature of the atmosphere prior to the tank being filled with water. The shuttering for these walls was eventually cleaned, creosoted and made into covers for the paddle-wheels.

The installation occupies the site of part of one of the existing storm-beds, and covers an area of less than half an acre.

The work was carried out by departmental labor, and cost £12,000.

Strength in its structure, accessibility in its parts, and simplicity in its working have been the aim in the design of this plant. The three sludge outlet valves at the settlng tanks are the only valves which require attention. Beyond this the attendant has only the machinery to watch. One man could give the necessary attention to three or four such plants if suitably arranged.

### Operation of the Aeration Tank.

In its operation the aeration tank may be compared to a river containing a very large number of oxidizing organisms capable of purifying putrescible matters. To this river or stream sewage is added in such volume as it is able to purify continuously.

A proportion of liquid is being continuously taken from the stream at a point remote from the inlet and equal in volume to that of the sewage which is being added. This portion passes to the settling tanks, when the purified liquid and sludge are separated.

### Operation of the Plant.

The authors would have preferred to delay for a time an account of the results of the operation of this plant, as it has only been working for about five months, and no attempt has yet been made to work it to its full capacity. It was, however, though that some information respecting its working and the observations taken might be of interest and probably lead to a helpful discussion.

The aeration tank was filled with sewage on Nov. 4, 1920, and about 40 tons of sewage sludge and humus collected from contact-beds, etc., were thrown in. After about twenty-one days' circulation the sludge had become matured and was found to contain ample biological life. In Nov. 26, 1920, sewage was admitted and one settling tank put into operation, the other two being started a few days later. From this date effluent has been discharged continuously, with the exception of a few odd days occupied in minor alterations and adjustments. The sludge or humus has been allowed to accumulate in the tank to the extent of about 25-30 per cent., any excess being periodically discharged onto a land filter.

During the first few weeks attention was specially given to determinations of velocities of flow by means of current meters, Pitot tubes and floats, in order to regulate the agitators to the required conditions with respect to their velocity, blade surface, etc.

### Character of Sewage Treated.

The plant was constructed specially for the purpose of dealing with sewage from the Tinsley district, and during the period from November 26th to February 18th the sewage from this district only was treated by the installation.

The dry weather flow from the district mentioned is approximately 250,000 gallons per day; about one-third of it is trade waste from large steel works and the remainder domestic sewage. All the sewage was passed through the plant up to three times the dry-weather flow. The trade wastes consist chiefly of acid salts of iron in the ferrous condition, iron pickle, cutting compounds from machine tools, slaughter-house waste, and generally traces of oil.

Before entering the aeration tank the sewage has been passed through a small detritus and screening chamber, and through roughing tanks of 20,000 gallons capacity, to remove the heavier solids.

### Character of Effluent Obtained.

The purification obtained was generally satisfactory, well oxidized and non-putrescible effluents being produced under all conditions.

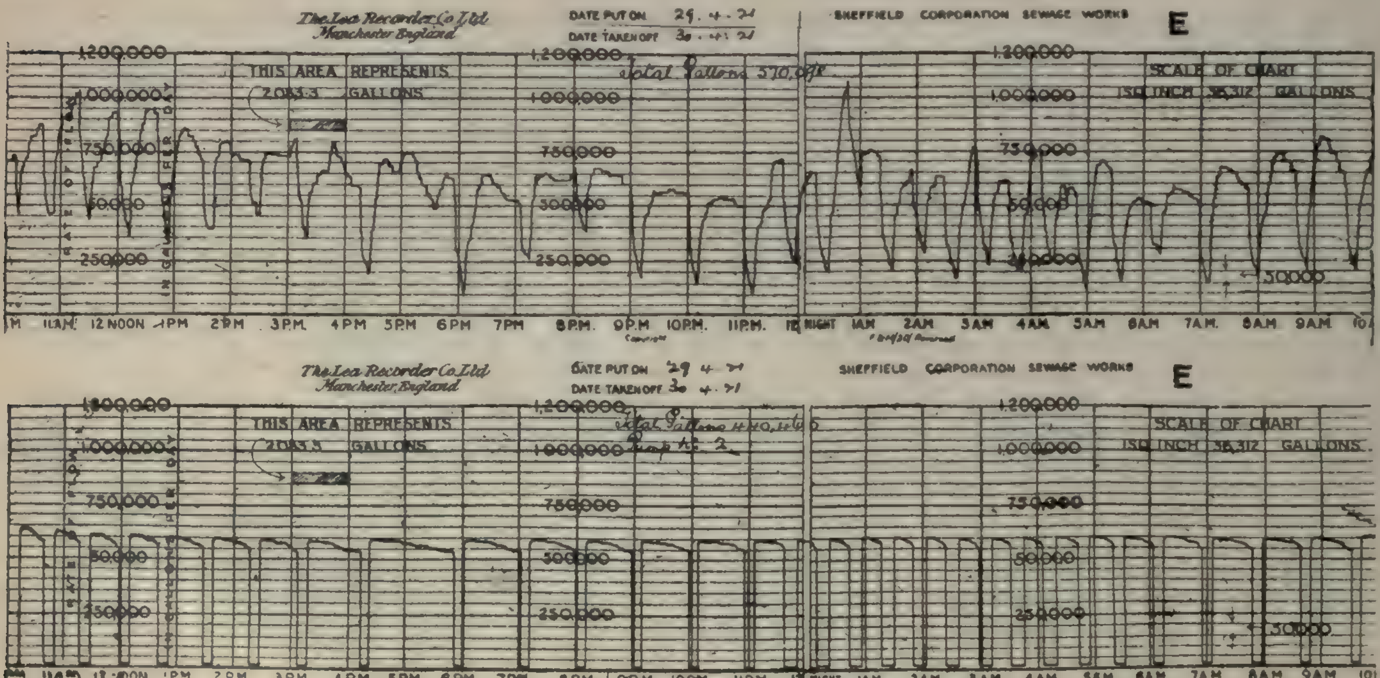


Fig. 6—Upper: effluent discharged; lower: sludge pumped.

On February 9th a very strong discharge of acid pickle entered the tank, followed on February 18th by a very abnormal discharge of petroleum and mineral oil. The effect upon the effluents produced was very marked. For several days the settled liquids were opalescent or emulsified in appearance, although from the chemical point of view they could not be described as bad, and were non-putrescible. It should be stated that such discharges would have interfered quite as seriously with the operation of bacterial filters of any type.

### Sheffield Sewage.

After the effluents had become quite bright and satisfactory again, it was decided to introduce a very strong sewage from the main works of the city. Sewage which had passed catchpits and tanks, but allowed to carry abnormal quantities of septic organic solids and containing sulphides of iron, was allowed to enter the aeration tank on February 22nd. The volume was gradually increased up to about 500,000 gallons per day. In view of the fact that the sewage was a very strong one, and probably stronger than any to which purification by bio-aeration has been applied, the results have been remarkable.

The effluents, almost without exception, have been non-putrescible and of a generally satisfactory character. The suspended solids have never been found to exceed three parts per 100,000. At times the effluents have shown slight opalescence which on examination microscopically has proved to be due chiefly to the presence of organisms such as vorticella, carchesium, and similar forms, and minute organic debris. The degree of nitrification, with the strong sewages mentioned, has not been very high, but the Sheffield sewage, containing more than 30 per cent. of trade wastes, has never, when treated by any bacteriological process, given the high figures for nitric nitrogen obtained with sewages of a different character.

The results of purification are set forth on the table Fig. 2, and diagram Fig. 3.

### Power Required.

The actual mean horsepower used daily by this "continuous-flow" plant, as calculated from the registrations of the watt-hour meter, and the volume of effluent passed up to the time of writing this paper, are shown on the diagram, Fig. 4. The pump horsepower and the volume of sludge pumped are plotted on the diagram, Fig. 5.

During the short period this plant has been at work and with the experience of the working of the "fill-and-draw" plant, it has been observed that the horsepower required to treat a given volume of sewage depends largely upon the strength of the sewage, and it seems probable that for treating a sewage of great strength 50 h.p. per million gallons per day will be required, while for a weak sewage probably half of this power will suffice.

It appears that whatever method of agitation or propulsion be adopted, a velocity of 1½ ft. per second must be attained in the aeration tank to keep the bacterial sludge in complete suspension. What further velocity or agitation, if any, is needed to reach the limiting possibilities of rapid aeration of the liquid and the period of time it takes to complete this aeration are matters for further investigation.

In the Sheffield tank a velocity of 1½ ft. per second requires a water horsepower of 9, so that an actual input horsepower of 20 would be required with a plant working at an efficiency of 45 per cent.

Diagram Fig. 6 shows two daily recorder charts, respectively, of the effluent passed and sludge pumped. Comparing these two charts, it is interesting to note how the action of the sludge pumps affects the effluent flow.

From a careful review of all the experiments which have been made, commencing from their early stage in 1914, followed by the small "fill-and-draw" plant installed at Tinsley in 1918, and finally by the new "continuous-flow" plant brought into service last November, the following table has been prepared showing the probable requirements for a complete "bio-aeration" installation:

| | "Fill-and-draw" | | | | "Continuous-flow" | | | |
|---|---|---|---|---|---|---|---|---|
| | Number | Total capacity in terms of D.W.F. | | | Number | Total capacity in terms of D.W.F. | | |
| | | Weak | Medium | Strong | | Weak | Medium | Strong |
| Screening and heavy grit chambers | 2 (or more) | 1.48 | 1.48 | 1.48 | 2 (or more | 1.48 | 1.48 | 1.48 |
| Detritus or sediment tanks (rectangular type) | 2 (or more) | [illegible] | [illegible] | [illegible] | 2 (or more) | [illegible] | [illegible] | [illegible] |
| Aëration tanks (4 feet deep | 8 (or more) | [illegible] | [illegible] | [illegible] | 2 (or more) | [illegible] | [illegible] | [illegible] |
| Settling tanks (upward flow type) | none | — | — | — | 2 (or [illegible] | [illegible] | [illegible] | [illegible] |
| Estimated h.p. required per 1,000,000 galls. per day treated | Circulation | 25 | 37½ | 50 | — | 25 | 37½ | [illegible] |
| | sludge pumps | *nil* | *nil* | *nil* | — | 5 | 5 | [illegible] |

Treatment capacity in time of storm = 3 D.W.F.
Storm water in excess of 3 D.W.F. to be treated in storm-tank.
Trades wastes of certain character might require special preliminary treatment

In view of the advantages in capital costs which bio-aeration processes promise, it is hoped that any plants laid down will be given ample capacity after careful inquiry as to the requirements of the particular sewages to be dealt with.

### The Humus or Sludge.

The humus or sludge provides many interesting and useful lines of study in respect to its production, mode of operation, and disposal. The most urgent and interesting problem at the moment is, however, that of dewatering the sludge, particularly as its nitrogen content may give it considerable manurial value. The authors have made experiments in which the sludge is spread in thin layers on wire gauze and then submitted to a slight vacuum. By this method the Sheffield sludge can be reduced from 98.5 per cent. to about 75 per cent. water content almost instantly, and this method of attacking the problem has so far given the most promising results. Experimental machines for further investigating this process are now being constructed to operate continuously. Suggestions have also been made that the wet sludge might be mixed with house refuse dust and then pressed or otherwise disposed of.

### General Conclusions.

It is yet too early to determine the final shape this new development in sewage disposal will take. The questions and possibilities still to be investigated are so numerous and varied and of such importance to the community that no individual or small group of individuals can hope to deal with them. It will therefore be a matter for regret if the Ministry of Health does not assist in the development of the work by at least encouraging and co-ordinating research by local authorities, etc. It may, however, be said that sewage, unless complicated by special factors such as difficult trade wastes, can be as efficiently treated by "bio-aeration" methods as by older methods, and the following advantages may be expected:

(1) Reduction in capital, renewal and maintenance costs, and in areas of land required.

(2) Working costs will not be excessive and manual labor will be reduced.

(3) Absence of nuisance from smell or flies.

(4) No diminuation in plant capacities, such as occurs in the case of bacterial filters.

(5) Increased manurial value of the sludge when satisfactory methods of dewatering have been developed.

The present disadvantages of the process appear to be:

(i.) That the process is not adopted to small flows of sewage where continuous skilled supervision would be too costly.

(ii.) That an uninterrupted supply of power is essential.

(iii.) That the difficulty of dewatering the sludge, except where ample land is available, has not yet been satisfactorily dealt with.

### Problems for Further Investigation.

Among the many points which still require careful investigation the following may be mentioned as examples:

(1) The variations in plant capacities and power to suit sewages varying in volume, strength and character, particularly with respect to the effects of trade wastes.

(2) The extent of preliminary treatment of the sewage needed before its admission to the aeration tank.

(3) The elasticity of plant to accommodate increased flows during periods of storm.

(4) The best division of plant into units for various flows.

(5) The most effective types of aeration tanks, and the best modes of agitation and design and distribution of agitators to give economy in the use of power.

(6) The best volumes of sludge to operate with various sewages, and the necessary periods of contact with the sludge in the aeration tank for various sewages.

(7) The best type and proportion of settling tanks to give minimum velocity of flow.

(8) The conditions causing periodic variations in bulk of the sludge.

(9) The "continuous-flow" and "fill-and-draw" methods of operation have their individual advantages and disadvantages. A comparison of these is worthy of further investigation.

(10) Studies of the changes in the biological life in the sludge.

(11) The dewatering, use and disposal of the sludge.

## British Industries Fair for 1922

The next British Industries Fair will be held in London and Birmingham between the 27th of February and 10th of March, 1922. The British Industries Fair is open to manufacturers in all parts of the British Empire, and buyers from all over the world are attracted. It affords an excellent medium for bringing manufacturers in direct contact with buyers, as only bona fide manufacturers are permitted to exhibit and buyers are admitted to the fairs by invitation only. The general public are not admitted. Full details regarding the fair can be obtained from H.M. Trade Commissioners at 248 St. James Street, Montreal; 260 Confederation Life Building, Toronto, or 610 Electric Railway Chambers, Winnipeg.

## Paving and Real Estate Developments

With housing conditions throughout the country only slightly improved, especially in the larger cities, and with the continued desire on the part of most city dwellers to have their homes in suburban or residential sections, instead of in the heart of a city, the subject of developing new residential areas has come to be of great importance among city engineers and city planners.

To be successful, new home areas must be beautiful and attractive, as well as within a convenient distance of the average person's place of work or business. In making these new real estate sections beautiful, realtors and city engineers have found that problem of paved streets is one of the first to be solved; and after considerable study and planning, they have decided that the type of pavement in a newly developed home area must have these features:

1. A pavement easily and quickly constructed.
2. Economical and low in first cost.
3. Beautiful in appearance and suitable for the traffic it is to undergo.

## Sturtevant Catalog

B. F. Sturtevant Company, Boston, have published a very interesting catalog, No. 278, entitled "Air Conditioning Apparatus." The term "air conditioning" has been coined by this company to give a name to this industry of regulating both the moisture content and the temperature of atmospheric air. The catalog is sylendidly illustrated, a number of actual instances where the air conditioning apparatus is at work being shown. The operation and construction of the equipment is also very thoroughly covered. An appendix contains a couple of interesting curves regarding atmospheric humidity; also a table covering the properties of saturated ammonia vapor from absolute pressure of 1 lb. per sq. in. up to 200 lbs. per sq. in. A second table covering the thermal properties of liquid ammonia at saturation pressure is also appended.

## Municipal Handbook of Toronto

"The Municipal Handbook of the City of Toronto," a valuable little publication produced annually by Mr. W. J. Littlejohn,, city clerk, has recently come to hand. It is attractively bound in a red cover and this year contains 150 pages. A quantity of very interesting and valuable information has been condensed into this small space.

# Mainly Constructional

**East and West—From Coast to Coast**

Fire losses in Canada during the week ended August 3 are estimated by The Monetary Times at $1,031,210, compared with $195,500 the previous week.

There is a current rumor to the effect that the General Accident Insurance Co. propose erecting a ten-storey office building at the corner of Bay and Temperance streets, Toronto, at a cost of $500,000.

Messrs. McDonald & Willson, Lighting Co., 309 Front St., Winnipeg, have been awarded the cantract for electrical work on a new school which is to be erected at St. Vital, Man., at an estimate cost of 60,000.

Dr. Hastings, Medical Health Officer at Toronto, recently stated that the building of houses on less than 20 ft. frontages did not allow sufficient light and ventilation to the occupants and was therefore prejudicial to health.

Eight floors of the new addition to the King Edward Hotel, at Toronto, have been opened for occupation. Work on the remainder of the building is being rushed to accomodate the crowds of visitors to the Toronto Exhibition.

The council of Halton County, Ont., recently voted the sum of $100,000 for the construction of good roads in the townships of Trafalgar, Nelson and Esquesing, in the following proportionment: Trafalgar, $40,000; Nelson $30,000, Esquesing, $30,000.

New construction in Canada during the month of July shows a considerable falling off as compared with June. The value of construction contracts awarded in July was $17,741, 400, compared with $26,436,800 in June—being a decrease of $8,695, 400, or 32.6 per cent.

A cut in wages of the men and teams employed by Wentworth County, Ont., on roadwork, went into effect recently. The reductions were as follows: Teams, from 80 cents to 70 per hour; foreman, from 55 to 50 cents per hour; laborers, from 40 to 35 cents an hour.

A novel feature of the asphalting of the Victoria Bridge at Montreal is the carrying on of the work during the night. The bridge will be closed every evening at 10 o'clock till 6 o'clock in the morning, when a roadway will be left clear for traffic during the daytime.

Contract for the new water works system at Richmond Hill, Ont., has been let and work will be completed by December 1, it is anticipated. The water supply will be drawn from Wilson Springs, the whole scheme comprising the erection of a dam, storage tank and filtration plant. The cost of the undertaking is $92,000.

Shaugnessy Heights, the beautiful suburb of Point Grey, B. C., is shortly to come under the city's control. The suburb contains a population of 800 and is the last word in town planning development in British Columbia. There are 154 residences in the district, each one being situated on its own spacious lot and none costing less than $5,000.

The following list of officers were elected at the closing session of the Western Canada Irrigation Association s meeting, held recently at Vernon, B. C.: Hon, president, Minister of the Interior, Sir James Lougheed. Presidents, Minister of Agriculture for Saskatchewan, Hon. J. A. Maharg. Hon. vice-presidents, the Minister of Agriculure for British Columbia, Hon. E. D. Barrow; the Minister of Lands for British Columbia, Hon. R. D. Pattullo; the Minister of Agriculture for Alberta; the Minister of Public Works for Alberta; the Minister of Highways for Saskatchewan, Hon. C. M. Hamilton; G. R. Marnoch, of Lethbridge; and W. H. Fairfield, superintendent of experimental farm Lethbridge. Vice-presidents, D. J. Wylie, Maple Creek; Walter Huckvale, of Medicine Hat. Executive, G. S. Herringer, of Maple Creek; Mayor Purcell, of Brooks; A. S. Dawson, chief engineer, C.P.R. irrigation systems of Calgary; V. Meek, of Calgary; G. M. Houston, of Lethbridge; Peter Lund, of Coaldale; G. S. Sterling, of Kelowna; and F. R. Simpson, of Summerland. Secretary, James Colley, of Calgary.

It looks as if a start will be made very shortly on Quebec City's extensive housing development. There are 165 houses in the program, which will cost $578,600. The Municipal Director of Housing, Mr. A. Trudel, has secured the approval of plans by all the authorities concerned and as there is a million dollar fund available for this work, actual operations should be under way soon.

## Personal

Mr. Fred. F. Pardee, M. P. for West Lambton, Ont., officiated at the laying of the cornerstone of Sarnia's new $500,000 collegiate recently.

Mr. F. H. Taylor, of Hamilton, was successful in having his design for a cenotaph in memory of the boys who fell in the war, selected. The contest, which was conducted by the Canadian Club, was limited to returned men only. Mr. Taylor is employed in the offices of F. W. Warren, architect, of Hamilton, and has had considerable experience in this line of work.

## Obituary

Mr. William Culford, superintendent of the Standard White Lime Co., Beachville, Ont., was killed at the company's plant recently. Deceased was working on a pole when he accidently touched a live wire and fell to the ground, dying in a few minutes time from his injuries. Mr. Culford was 34 years of age and had been in charge of the above plant for several years.

## Trade Incorporations

H. A. Wickett Co. Ltd., with head office at Toronto, capital $40,000, to erect wharves, docks, piers, bridges, etc.

Brittain Sand and Gravel Co., Ltd., with head office at Brantford, Ont., capital $40,000, to deal in sand, gravel, etc.

Matheson Brick & Tile Co. Ltd., with head offiice at Hamilton, Ont., capital $40,000, to manufacture and deal in brick, sewer pipe, etc.

Muxlow & Gale Constructing Co. Ltd., with head office at Windsor, Ont., capital $40,000, to carry on a contracting and building business.

Elmstead Brick & Tile Co. Ltd., with head office at Windsor, Ont., capital $200,000, to manufacture and deal in brick, terra cotta, drain and sewer pipe, etc.

The Delta-Star Electric Company, Chicago, Illinois, have ready for distribution a new forty-eight page publication describing complete line of new "Air Brake High Voltage Switches." This bulletin is No. 36 and will be mailed upon request .

# NEWS OF CONTRACTS

## Period of August 10 to August 16, 1921

*Dominion Wide Service Exclusive to "Contract Record & Engineering Review"*

### Waterworks, Sewerage and Roadways

**Kingsville, Ont.**
F. W. Thorold Co., Ltd., Engrs., 54 Admiral Rd., Toronto, have plans and will receive tenders until Aug. 22nd for pressure filters for waterworks for Town.

**Leclercville, Que.**
Construction of aqueduct is planned by Council.

**Mandaumin, Ont.**
Duncan Smith, R. R. No. 5, Forest, Ont., Commr., has plans and will receive tenders until Aug. 20th for construction of drain for Plympton Twp. Council.

**Toronto, Ont.**
W. A. McLean, Deputy Min. Dept. Highways, Prov. Govt., will receive tenders until Aug. 25th for construction of concrete culverts in Monaghan S. and Cavan Twps. Plans with Dept. and D. W. Bews, Res. Engr., Port Hope, and A. H. Parker, Res. Engr., Cornwall. 10 per cent. Guaranty Bond required.

Tenders will be received until Aug. 25th by W. A. McLean, Peputy Min. Dept. Highways, Prov. Govt., for construction of macadam base in Edwardsburg Twp. Plans with Dept. and Res. Engrs., D. W. Bews, Port Hope, and A. H. Parker, Cornwall. Guaranty Bond for 10 per cent. required.

Tenders will be received until Aug. 25th by W. A. McLean, Deputy Min. Dept. Pub. Highways, Prov. Govt., for grading in West Sandwich Twp. Plans at offices of Dept., and W. M. Webb, Res. Engr., Kingsville, Ont. Guaranty Bond for 10 per cent. required.

W. A. McLean, Deputy Min. Dept. Highways, Prov. Govt., will receive tenders until Aug. 29th for construction of concrete culverts in Mersea Twp. Plans at offices of Dept., and W. M. Webb, Res. Engr., Kingsville, Ont. 10 per cent. Guaranty Bond required.

W. A. McLean, Deputy Min. Dept. Pub. Highways, Prov. Govt., will receive tenders until Aug. 29th for grading and macadamizing in McNab Twp. Plans at office of Dept., and R. A. Smith, Res. Engr., Renfrew, Ont. Guaranty Bond for 10 per cent. required.

#### CONTRACTS AWARDED

**Belmont, Man.**
W. H. Oliver, Oak Lake, Man., has general contract for grading costing $15,000 for Mun. of Strathcona, Belmont, Man.

**Clandeboye, Man.**
General contract for construction of culverts costing $12,000 for Mun. of St. Andrews, Clandeboye, is awarded to La Cour & Schoiler, Clandeboye.

**Conn, Ont.**
Gneral contract for construction of drain for West Luther Twp. is awarded to McDonnell Bros., Kitchener, Ont.

**Devon, N.B.**
General contract for intake pipe costing $40,000 for Town is awarded to Gale Bros., St. John, N.B. Contract at $10,000 for 6 in. and 8 in. Douglas Fir woodstave pipe is awarded to Pacific Coast Pipe Co., 1551 Granville St., Vancouver, B.C.

**Kingsville, Ont.**
General contract for construction of sewers costing $38,00 for Town is awarded to B. Oldani, 921 Dougall Ave., Windsor. Contract for sewer pipe is placed with D. H. McClay, Kingsville.

**Lauzon, Que.**
Contract at $15,990 for steel tank for waterworks system costing $300,000 for Municipal Council is placed with Canadian Des Moines Co., Ltd., Inches Ave., Chatham, Ont.

**Lloydminster, Sask.**
General contract for roadwork costing $8,500 for Prov. Govt., Dept. of Highways, is awarded to Western Construction Co., North Battleford, Sask.

**Niagara Falls, Ont.**
Johnston Bros., 43 Market St., Brantford, Ont., have general contract for constructon of trunk sewer costing $238,000 for City.

**Oakbank, Man.**
General contract for construction of culverts and roadwork for R. M. of Springfield is awarded to Western Engineering & Construction Co. 107 Florence Ave., Oakbank.

**Orillia, Ont.**
Town Council awarded general contract for paving 2 in. bitulithic top on concrete base to Warren Bituminous Paving Co., Ltd., University Ave., Toronto. Report in last week's issue was erroneous inasmuch as address of contractors was given as "McKinnon Bldg., Toronto," and project as "reinforced concrete pavement."

**Richmond Hill, Ont.**
Additional contracts for waterworks costing $90,00 for Town are: Laying watermains, F. F. Fry, 43 Scott St., Toronto; pipe, National Iron Corp., Cherrry St., Toronto. steel tank, Canadian Des Moines Steel Co., Inches Ave., Chatham, Ont.; filter equipment, General Supply Co., 38 Toronto St., Toronto; filter bldg., pumphouses and bridge, Reid & Somers, Elora, Ont.; gate valves and hydrants, Drummond, McCall Co., 373 Front St. E., Toronto; pumping machinery, Northern Foundry Co., Sault Ste. Marie, Ont.

**Winnipeg, Man.**
Council awarded following contracts: Sidewalks, at $10,708.90, City Engr., 223 James St.; paving, City Engr.; sewer, City Engr., sewer, Messrs. Fowler & Young; granolithic walks at $11,886.60, Thos. Jackson & Sons; watermain, Thos. Jackson & Sons; sewers, Thos. Jackson & Sons.

### Railroads, Bridges and Wharves

**Aurora, Ont.**
G. T. Rly. will construct subway at cost of $25,000.

**Bloody Island, Que.**
A. Johnston, Deputy Min. Dept. Marine and Fisheries, Dom. Govt., Ottawa, will receive tenders until Sept. 1st for construction of reinforced concrete pier. Plans with Dept., Agency of Marine and Fisheries, Montreal, and post offices of St. Johns, Iberville, Chambly, Lacolle and Sorel, Que. Accepted cheque for 10 per cent. of tender required.

**Chatham, Ont.**
L. A. Pardo, Harrison Hall, Chatham, Kent County Rd. Supt., will receive tenders until Aug. 20th for construction of two bridges for Kent County Council. Plans with W. G. McGeorge, Engr., 153 Queen St., Chatham. Marked cheque for 5 per cent. of tender required.

**Hamilton, Ont.**
Express bldg. costing $35,000 is being erected by G. T. Rly.

**Marysville, Ont.**
Station costing $13,000 is being erected by G. T. Rly.

**Ottawa, Ont.**
R. C. Desrochers, Secy. Dept. Pub. Works, Dom. Govt., Ottawa, will receive tenders until Aug. 24th for repairs to three wharves. Plans with Dist. Engr., Victoria, B.C., and post offices at North Gabriola, North Pender and South Pender Island.

**Sarnia, Ont.**
Construction of wharf is contemplated by Imperial Oil Co., Sarnia.

**St. Bruno, Que.**
Overhead bridge is being rebuilt at cost of $11,000 by G. T. Rly.

**Ste. Justino do Newton, Que.**
L. Cousineau, Secy.-treas. of Municipal Council, has plans and will receive tenders until Aug. 20th for construction of bridge. Plans also with J. E. P. Deguire, Mayor.

**Tofino, B.C.**
R. C. Desrochers, Secy. Dept. Pub. Works, Dom. Govt., Ottawa, will receive tenders until Aug. 26th for construction of wharf. Plans with Dist. Engr., Victoria; and post offices at Vancouver and Tofino. Accepted cheque for 10 per cent. of tende rrequired.

**Toronto, Ont.**
H. A. Dixon, Winnipeg, Man., Chief Engr. C. N. Rlys., has plans and will receive tenders until Aug. 18th for construction of various projects in Manitoba and Saskatchewan, and include construction of reservoir, dams, subway, fencing, sewers, water sprinkler system, etc. Plans with Dist. Engr., Saskatoon; Dist. Engr., Ed-

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## *Why Should Contractors Not Be Salesmen?*

The electrical industry, more especially in the United States, has made something of a reputation for aggressiveness, and certainly has succeeded in greatly developing the electrical business by setting aside from time to time a certain number of days, generally a week during which they make a special effort to attract the attention of the public to one phase or another of the electrical industry. Thus, for example, they have had what they designated ''Prosperity Week'' and ''Silent Servant Week.'' During these periods they intensified their sales efforts, marshalled all their arguments, and by co-ordinated effort succeeded in getting the people to think along the desired lines. The concentrated effort only lasted a short time, but the results were spread over a long period and were found to be cumulative.

Now they're planning a ''Resumption Week.'' They are going to throw all their energy—all their power of salesmanship—into a co-operative effort to get the public into the way of buying as usual.

It has often occurred to the writer that the great need of the building and construction industry is more of this aggressive, co-operative sales effort. During the present period of depression it needs it very much, indeed. What is the average contractor doing today? Sitting back in his armchair and bemoaning the lack of building orders! Micawber-like—waiting for something to turn up. Why should the contractor stand on his dignity in this way? Such conduct, to be sure, is considered necessary in the medical or legal profession—but in the business world—no! What would become of the life insurance agent who waited for business to come to his office?

Wouldn't it be a good idea if contractors, either singly or collectively, could take a sort of inventory of the needs of their customers, reach a definite conclusion as to the actual building needs and then—go out and sell these buildings to their clients?

There is plenty of building in prospect—but your clients are afraid. If you yourself—a contractor—are convinced that this is the right time to build, surely you can convince a layman, who knows much less about it than you do. The fault seems to be largely with the lack of salesmanship on the part of contractors.

## *Whv is Business Bad?*

A portrait painter sat in a French cafe, sipping his wine. His small bottle was finished and he was about to order more when his eye fell on a newspaper lying near. He read the headline, "'Hard Times Are Coming."

"Hard times," he said. "That means we must economize." So, instead of calling for a fresh bottle, he called for his bill.

The landlord knowing the artist's habits, and surprised that the order for a second bottle was not given, said:

"Why are you going so soon; Is my wine not good?"

"Excellent," said the artist, "but hard times are coming and I must economise.".

"Ah," said the ladlord, as he called his wife. "You must make cotton do instead of that new silk dress you ordered. The artist says hard times are coming. We must economize. Cancel your order."

When the landlord's wife cancelled her order she told the dressmaker what her husband had said and remarked that they would all have to prepare for hard times. As soon as she had gone the dressmaker put on his hat and went across the street to the contractor's shop.

"Hard times are coming and this is no time to expand," said the dressmaker. "The improvements I had intended to make must wait. Do not proceed with the work. Under the circumstances, I cannot invest money. I must economize."

When the dressmaker left, the contractor sat down and wrote:

"My dearest artist friend: I really must postpone the sitting for my portrait. We are going to have hard times and I think it is best to wait until things are more settled before indulging in this expense. Hard times must be regarded."

The next day, when the artist received the letter from his friend the contractor, he betook himself to the cafe he was wont to visit. He ordered a small bottle—just enough, he said, to soothe him. As he sat there sipping his wine his eyes fell on the same newspaper he had seen before. He picked it up and scanned more closely and discovered that it was two years old!

There may be much fiction, but there is also much truth in the above. "Hard times" is, to some extent, an attitude of mind. There are so few people in this old world who think for themselves and so many who give credence to what other people, as thoughtless as themselves, say. Let us just for a moment reverse the story and see what happens: The painter reads "times are good." The landlord then encourages his family to buy more from the tradesmen, who in turn increase their own demands. One story is just as easy as the other—just as reasonable and logical. Applied to building the argument is just the same. How long are we Canadians going to "mark time."—not even able to whistle to keep our courage up? We are all too much like the artist in this story

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## *The Canadian National Exhibition*

During the next two weeks—August 27 to September 10—the Canadian National Exhibition in Toronto will again open its gates to the public, achieving, it is anticipated, a record in attendance that will surpass anything that has yet been accomplished. This Exhibition, now in continuous existence for over forty years, has been long recognized as an established institution in the life of Canada, but to the keen observer of the results that have been obtained through its agency it is far more than that—it is, indeed, one of the greatest educating forces operating in this country to-day, teaching those who visit its exhibits more of this country's potentialities and opportunities than they have ever known or dreamed of. It is, indeed, an epitome of all that Canada has to offer in its varied spheres of developed and undeveloped resources..

Those who administer the Exhibition, and those who participate in it through the exhibits they arrange, are well aware of the force with which the resources of Canada are brought to the direct attention of the public by its means, and each year they observe a greater demonstration of the hold which the Fair has upon the minds of those of its patrons. But the directors and exhibitors have lately been seeing that the Canadian National Exhibition does far more than interest Canadians—in fact it has now obtained a reputation that extends world-wide in extent. Visitors from the four corners of the globe are numbered among the million or more people who in two weeks visit the Exhibition, and they carry back to the countries from which they came stories of the wonderful possibilities that are contained in Canada. This country is thus establishing a reputation in foreign lands for which the Canadian National Exhibition is in no small degree responsible. This institution cannot, therefore, be considered as purely a National Exhibition, but as, indeed, a World's Exposition—the greatest institution of its kind on the globe.

In the exhibits, displays and demonstrations of the Exhibition there is enlightenment and education for visitors of every taste, and for contractors, engineers, and others of our readers, many special attractions will be of interest. We urge all those who can, to make it a point of visiting the fair during the next two weeks—a visit that will be repaid, we feel sure, manyfold in the new knowledge that they will obtain about matters of general importance, as well as of immediate concern to the particular pursuits in which they are interested.

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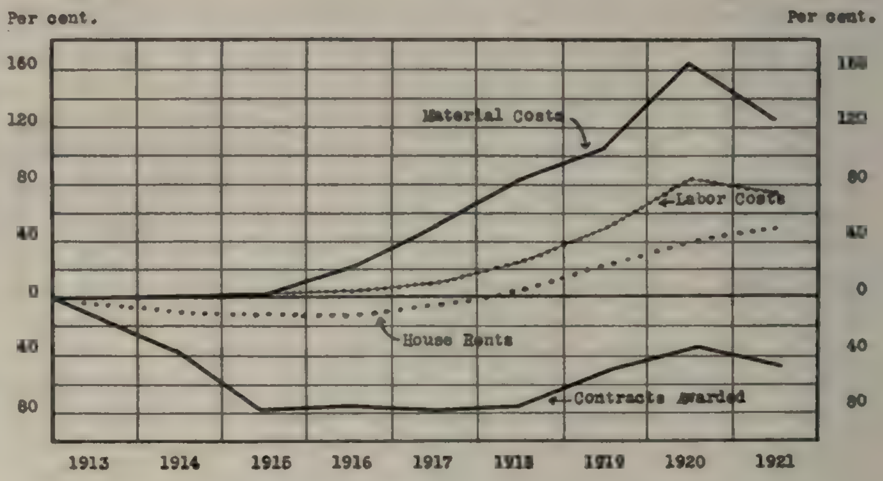
# *Will Falling Costs Revive Building?*



During the summer of 1919 private building revived sharply. This revival, however, soon felt the effects of a sharp jump in costs. By May of 1920, material costs had reached a point 183.8 per cent in excess of 1913. Material costs subsequently have fallen so that in June of this year the wholesale prices of 48 building materials had receded to a point 114.3 per cent. above pre-war. Wage rates in seven leading building trades in 1920 reached a point 80.9 per cent. in excess of 1913, and have since dropped to a point about 73 per cent. above pre-war levels. House rents for the average wage-earner have reached a point 50 per cent. above the pre-war. Obviously, a further fall in building costs is needed, and to this wage reductions must contribute. Construction contracts awarded during 1920 were 35.2 per cent. less than the 1913 total, and the average for the first six months of this year is 43.6 per cent less than the pre-war. These figures compiled by the MacLean Building Reports, Limited, cover the usual small town and the rural districts as well as the large cities. Consequently these statistics are the most authoritative and comprehensive in the field they cover.

NOTE:—The year 1913 was taken as the base year, that is, the figures for 1913 were taken as 100, and the figures for each year brought to a percentage of the figures for 1913. On the chart the figures for the year 1913 are marked 0 instead of 100, so that the figures for the other years represent the percentages by which these fall below or surpass the 1913 figures. In preparing the chart, monthly figures were averaged and plotted accordingly in each year. Consequently, the high peaks attained in any one month are not shown. For instance, material costs in May, 1920, reached a peak price 183.8 per cent. above 1913, whereas the average for the year was 164 per cent. above the pre-war. In June, 1921, material costs had receded to a point 114.5 per cent. above 1913, or 24.4 per cent. below the peak. Former comparisons have been based on the average cost of materials from 1890 to 1900, and not on 1913 costs, as in this comparison.

# Progress on the Chippawa Power Development

## A Description of the Work to Date on this Mammoth Project—Illustrations on the Next Three Pages Indicate Some of the Outstanding Features of the Development

From the Bulletin of the Hydro-Electric Power Commission of Ontario.

Through the combined efforts of the entire staff, progress on the Queenston-Chippawa Depelopment is being kept well up and the work is rapidly taking on the appearance of a finished power development.

The intake section, which is at the junction of the Welland and Niagara Rivers, is progressing satisfactorily. A section of the coffer dam has been placed in position at Hog Island. Some idea of the magnitude of this work may be had from Fig. 1, which shows the sheet piling and the dredges operating for the purpose of deepening the channel.

Proceeding up the Welland River or Chippawa Creek, the work of excavation is being accomplished by a Lidgerwood cableway, and is making satisfactory progress towards deepening the canal in this section. At the section where the canal enters the Welland River the suction dredge Cyclone is operating. This dredge was obtained from the Toronto Harbor Commission, and is holding its own with a splendid degree of satisfaction beside the huge shovel dredges which are being used for the purpose of excavating the canal proper.

The work of the rock section is also proceeding wiht a great degree of satisfaction. At the present time a number of shovels are working on the section between Lundy's lane and Montrose. The method in use is to operate on a series of benches or cuts resembling stair steps, with one shovel following the other, until the proper grade is obtained. This is the last rock section to be excavated, and with excellent progress being made, it should be finished well on time.

In order to obtain the greatest flow of water passing through a canal it is necessary to have the sides and bottom made as smooth as possible to reduce the friction; this is accomplished by lining the canal with concrete. Some idea as to the task of lining may be obtained from Fig. 3, which shows one of the concrete mixers laying concrete in the botton of the canal. Fig. 6 shows the steel forms set up for the purpose of lining the sides. Before this lining can be poured it is necessary to first remove all loose rock from the sides; this is done by a scaling gang which precedes the lining operations. The photographs shown previously refer only to the rock section. Some idea, however, may be obtained from Fig. 7 as to the nature of the lining used in the Earth Section, which crosses the Whirlpool Gulley. In this case the lining is placed at an angle and is reinforced by steel rods. Proceeding down the canal the forebay is finally reached, where a different type of lining is used to that of the canal proper. The flow of the water in this section is reduced to a very small rate, and, therefore, it only becomes necessary to seal the rocks forming the sides. A lining is, therefore, being put on with a cement gun to a depth of a few inches.

Fig. 2 shows the progress made on the power house up to May 6th. This view is taken from the American side and gives a comprehensive idea as to the work being done. On the sky-line may be seen towers supporting cables, concrete troughs and so forth. Most of these are used for the purpose of delivering concrete to the screen house and ice chute, as well as to the power house proper. On the escarpment face will be noted a series of holes a few feet from the top; these holes are the points where the pipe lines of penstocks will emerge on their downward passage to the power house. The Dominion Bridge Company has the contract to erect these and has its plant all installed at the present time, and is actively engaged on the installation. Slightly lower down on the picture may be seen the concrete mixing plant, which mixes all of the concrete used in the power house proper. Fig. 3 shows workmen erecting one of the draft tube forms. Immediately over this as shown in Fig. 4. one of the 55,000-horsepower turbines is installed. Some idea as to the magnitude of this machine may be obtained from the relative size of the workman engaged on its installation. No. 1 turbine was installed previous to this and is practically complete.

In Figs. 9 and 10 may be seen views of the progress being made on the power house building. In Fig.9 the construction railway, which brings in the material from the sorting yard located near Queenston, may be readily seen, as well as the American shore and Niagara River in the background. The building will be constructed in two main sections—the front section used for the generators and the rear for the transformers and switching equipment. The structural steel for the front section of units No. 1 and 2 is practically all in place. The three panels shown in the foreground form part of the rear section, the centre one of which will be used for the elevator shaft. The top beams shown above are at the roof elevation, which is, approximately, half way up the esccarpment of 160 feet above mean river level. Referring again to Fig. 10, some detailed views may be seen. These cranes are designed to operate as units or in conjunction with each other for the purpose of lifting weights up to 300 tons. In the lower foreground the progress may be seen with regard to the work on No. 4 unit. On the wall of the river side of the building may been seen the air inlets for No. 3 generator. It wil thus be seen that work on this structure is rapidly approaching a point where power will actually be delivered for use on the peoples' system.

As a matter of interest, Fig. 8 is shown for the purpose of giving some idea as to the structures necessary on the Welland River.

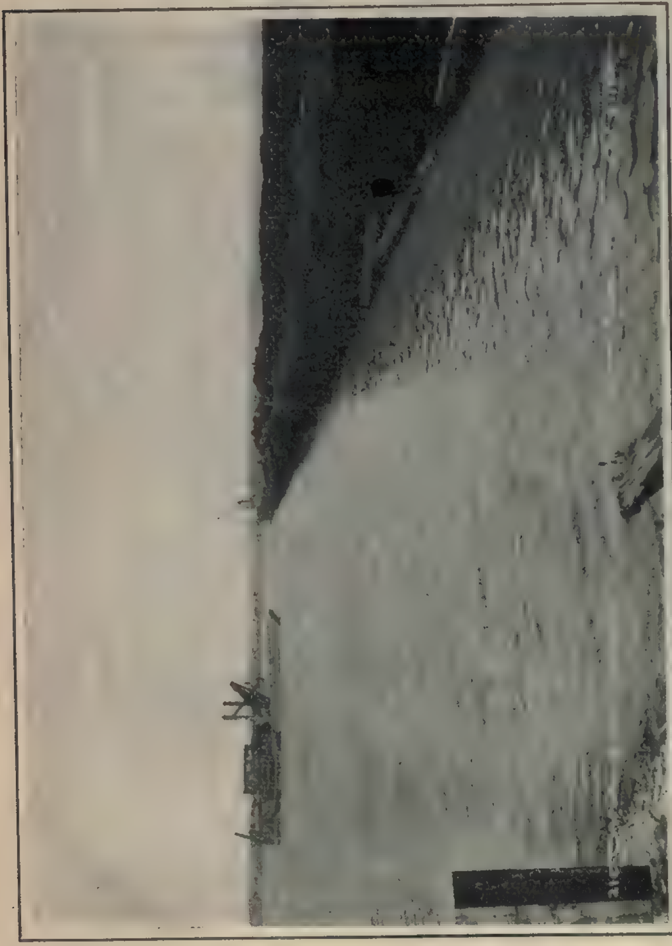


Fig. 1—Dredge working at canal intake.

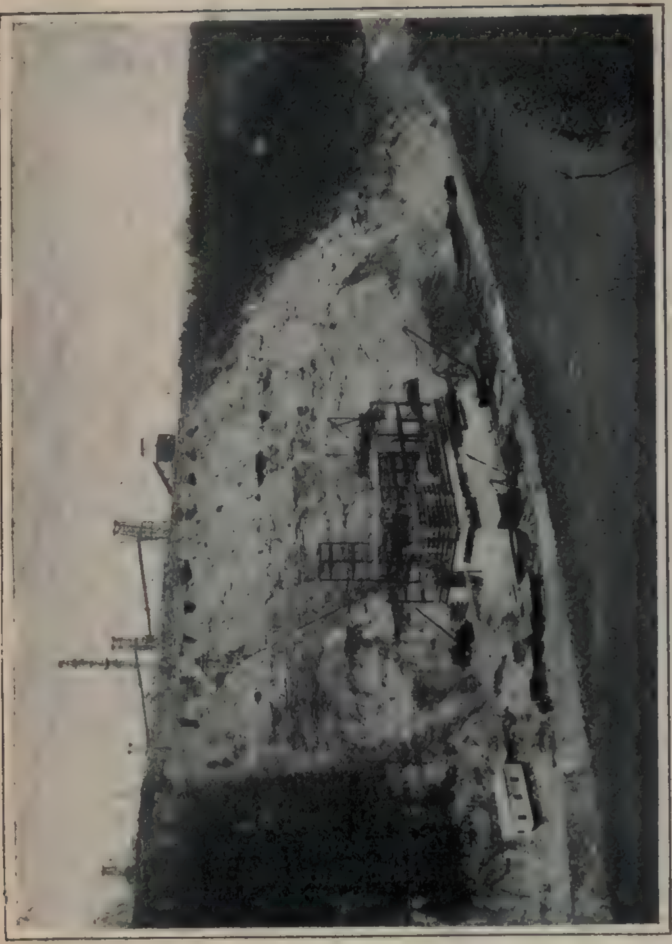


Fig. 2 Queenston generating station under construction. Holes at top of cliff show location of pipe lines from forebay.

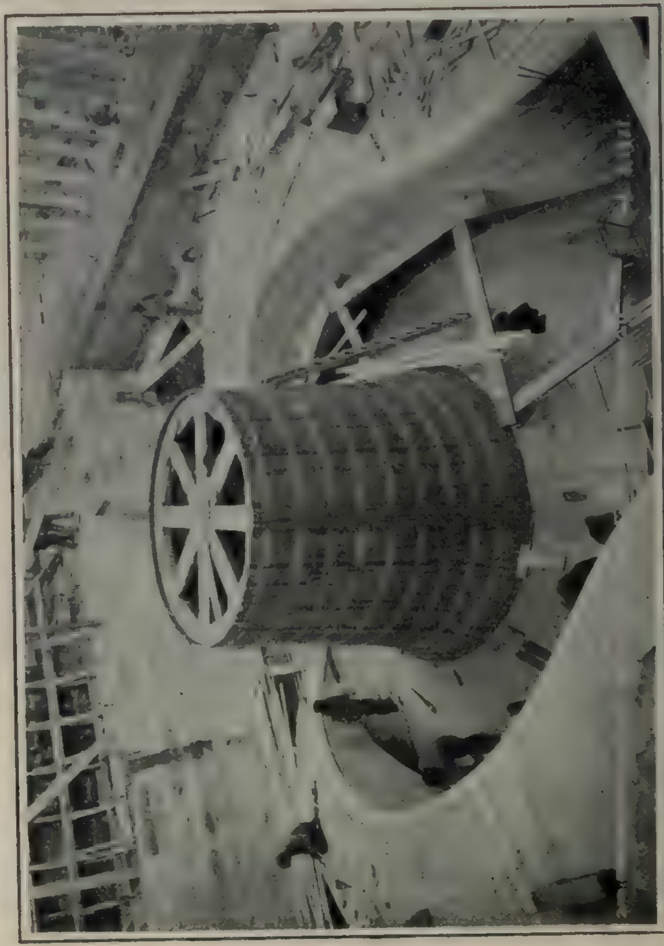


Fig. 3 View showing draft tube form.

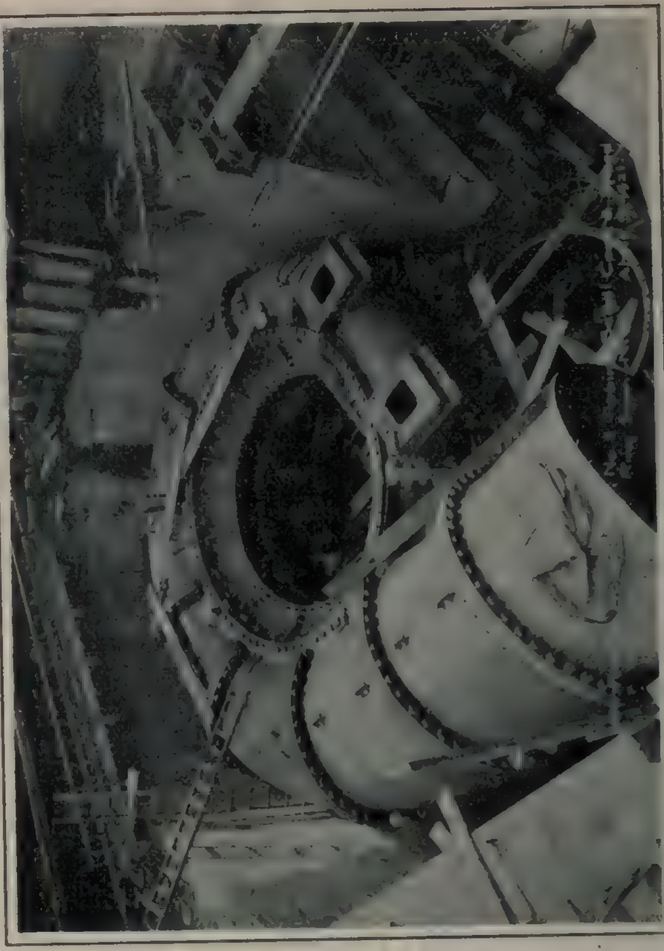


Fig. 4 No. 2 turbine scroll case being installed.

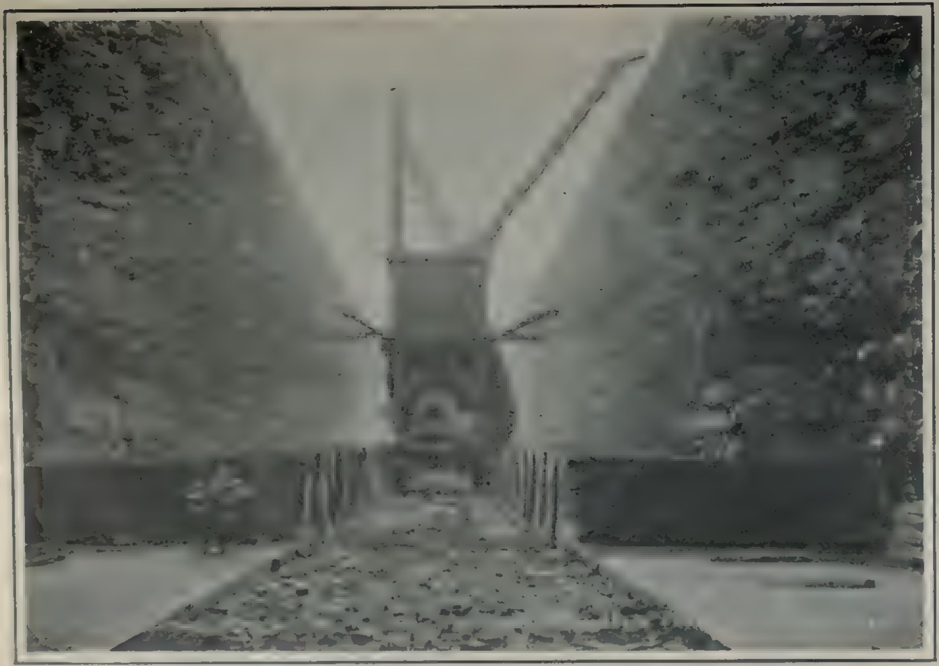


Fig. 5. Concrete plant laying floor in rock section of canal.

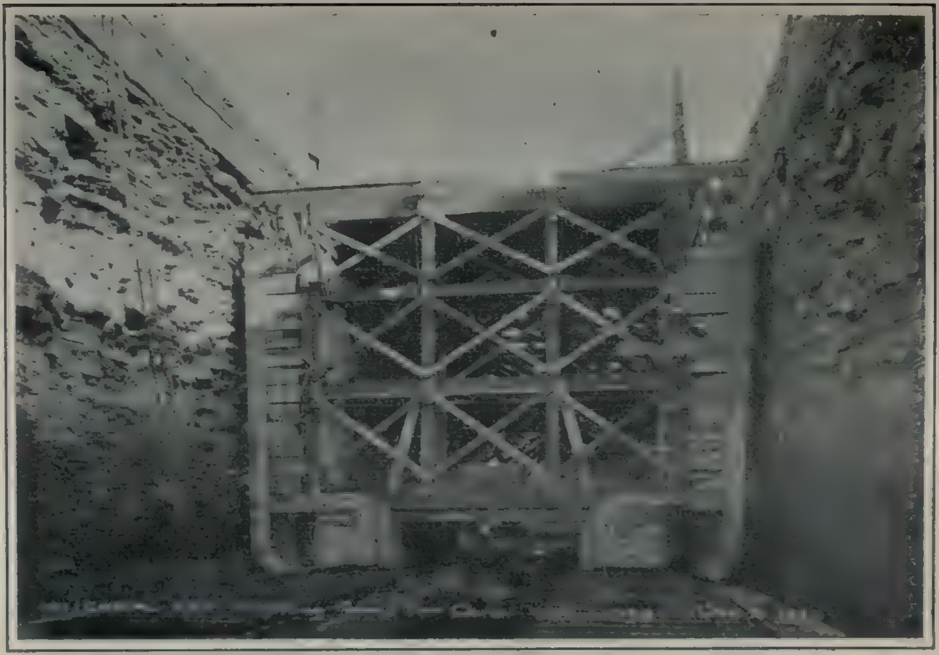


Fig 6—Travelling forms for canal wall lining.

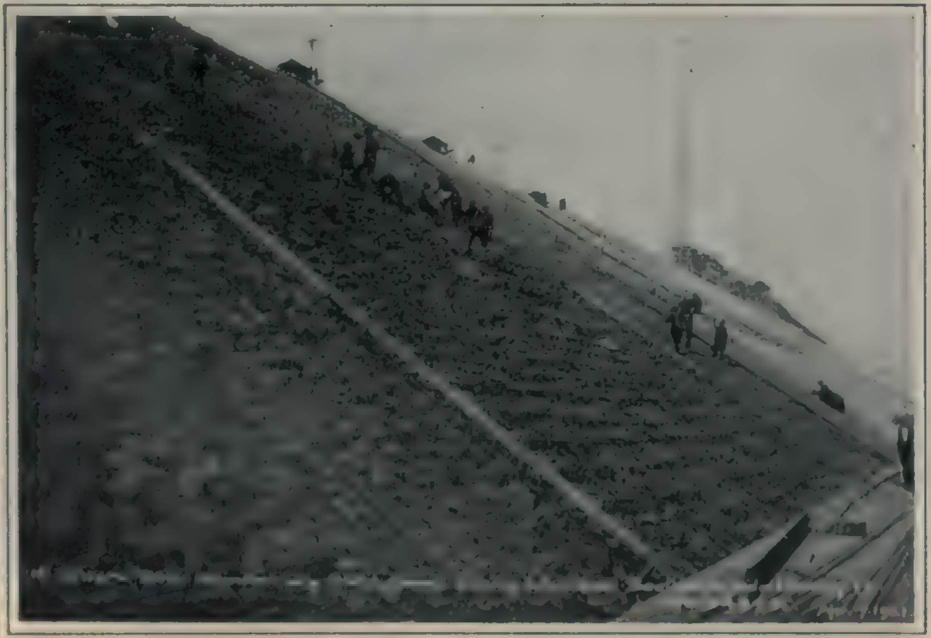


Fig. 7 - Reinforcing steel for canal lining, Whirlpool section.

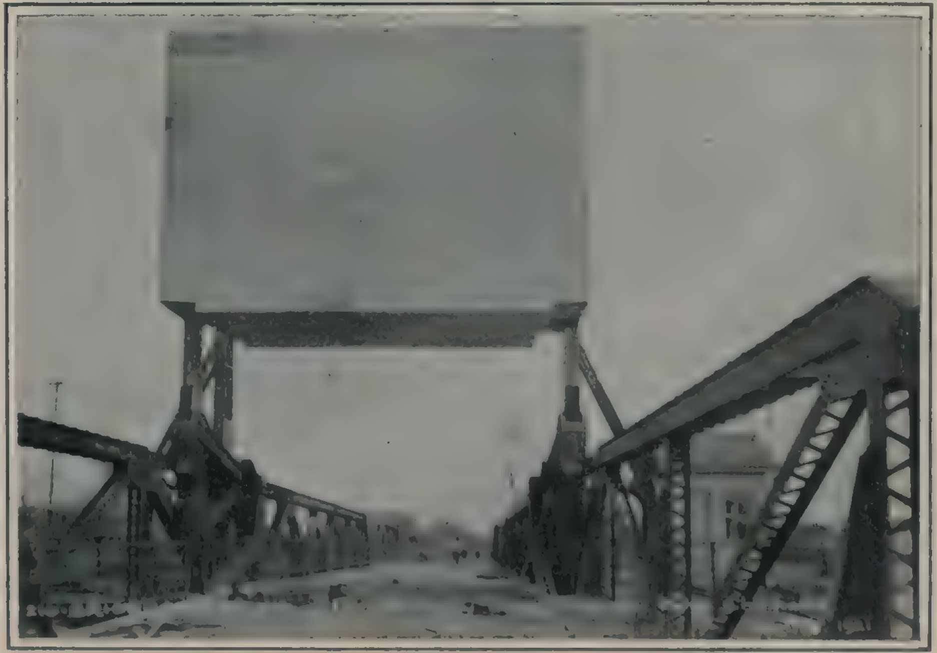


Fig. 8—New highway lift bridge at Chippawa.

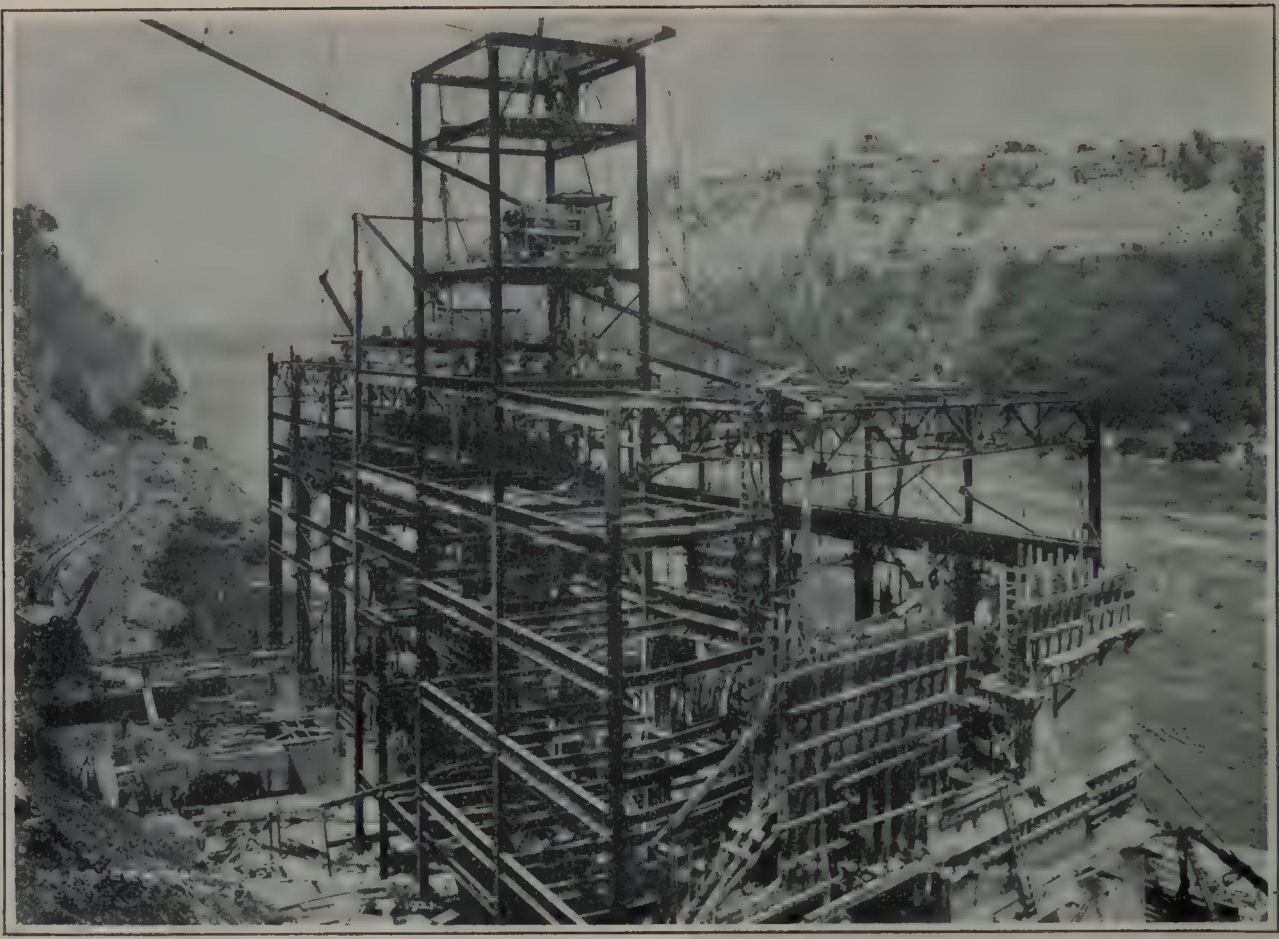


Fig. 9—Looking down the river, showing steel work of Queenston generating station under construction.

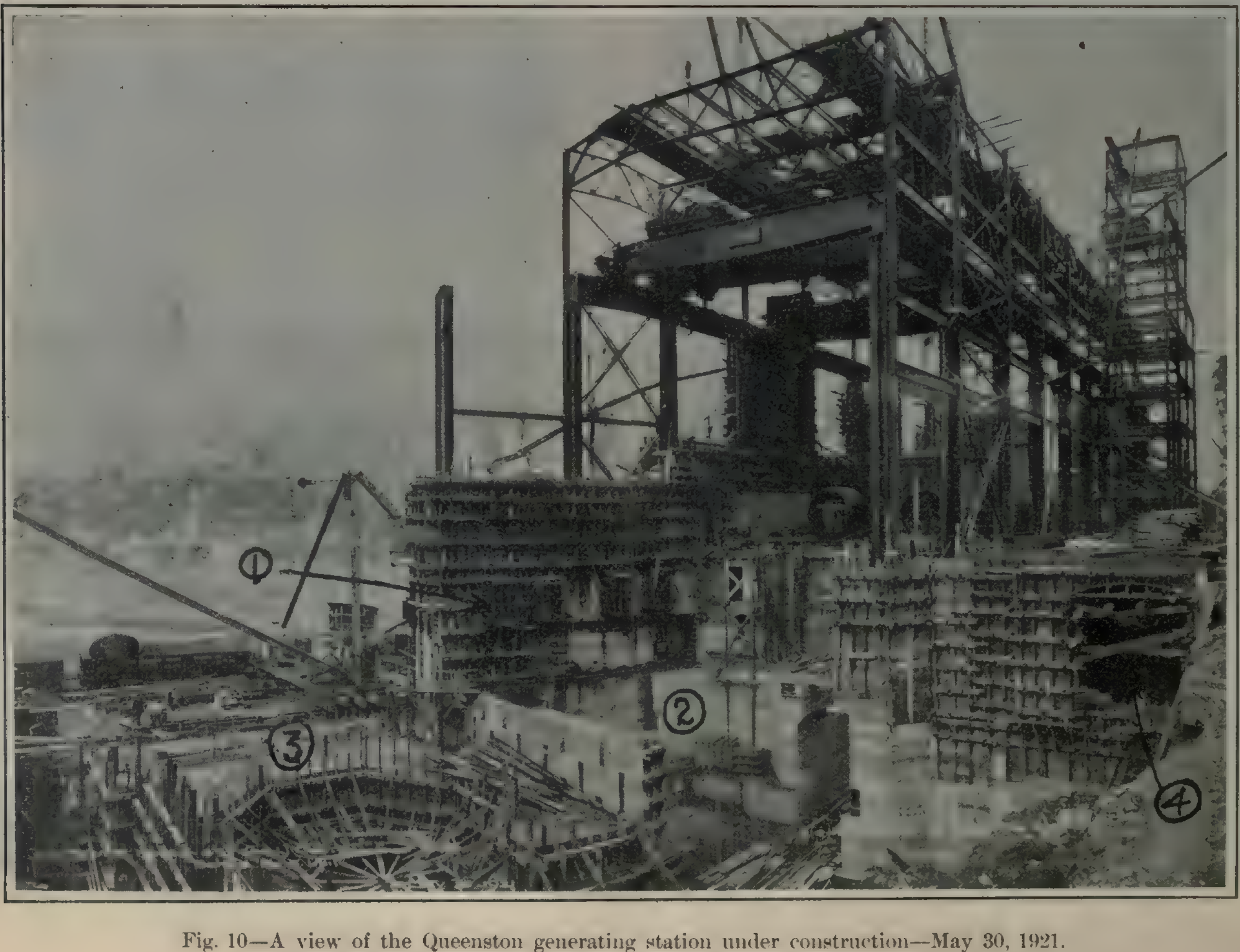


Fig. 10—A view of the Queenston generating station under construction—May 30, 1921.

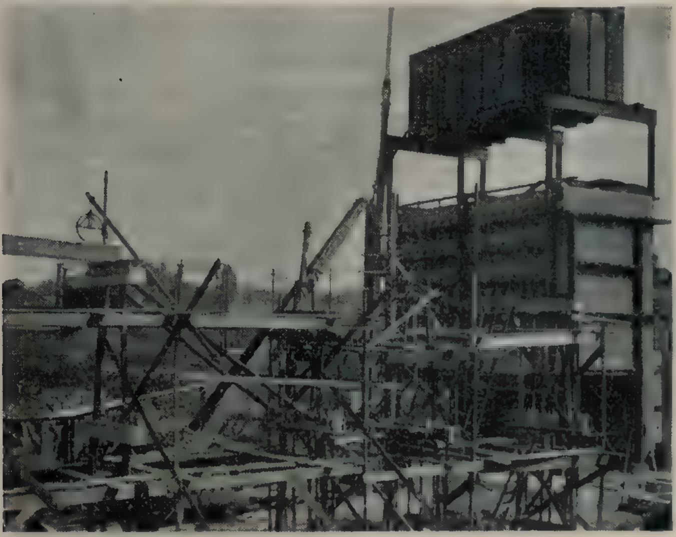
# Extensions to the Plant of the Victoria Gas Co.

By J. B. Holdcroft, A.M.E.I.C., Consulting Engineer.

The extensions which the Victoria Gas Company are making to their plant in Victoria, B.C., will practically double the capacity of the plant, and ensure an adequate supply of gas to the city for some time to come. The old plant has given very good service, but is of the old type with horizontal retorts, hand charged, and it is probable that the addition will become the principal unit, with the old plant remaining as a stand-by.

The new retorts are on the Glover-West system, with vertical, continuous charging retorts and automatic coke extractor. They will have a capacity of 500,000 cubic feet of gas per day, which for the present, will be transmitted to the existing purifiers and prepared for the storage in the gasometers.

The plant is being erected by the West Gas Improvement Company of Manchester, England, who have a branch office in New York, from where this work is being handled. The same company have erected similar plants, though of larger capacity, in Montreal and in Vancouver, B.C.



General view of Victoria Gas Co's. extensions.

In connection with this work the Gas Company are also installing a new coal storage system which has some interesting features. The coal is to be unloaded from scows to a stock pile by a clam-shell bucket operated by a stiff-leg derrick, the distribution being provided for by an overhead, automatic one-ton car, running on an inclined track. The track is supported by a trestle of rather curious construction, consisting of supporting members of 6 in. and 4in. cast iron pipes, which the company had in stock, filled with concrete, and with the ends bedded in reinforced concrete sills and caps. Lower bent posts are of 6 in. pipe, upper bent posts and all bracing members are of 4 in. pipe. This structure was designed as a measure of economy by the Gas Company's engineer, Mr. K. M. Chadwick, A.M.E.I.C., and it is anticipated should prove entirely satisfactory, provided individual members are not subjected to lateral blows or jars to any severe extent.

A concrete tunnel has been built under the site chosen for the stock pile, and will be used to house the belt conveyor and coal weighing machinery. Chutes are provided at suitable intervals so that coal may be taken from any part of the pile at will, and carried by the belt to a bucket elevator which will raise it to the level of the hoppers over the retorts.

The operation of this plant will, it is expected, show a great saving in labor costs. The retorts alone will be continuously operated by three men, while the old plant is now employing on charging alone, under summer conditions of consumption, a force of eleven men. Added to this saving will be the automatic operation of the coal conveyors, so that the value of the alteration from this point of view is very great.

The total cost of the work in hand is expected to be $200,000.

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# Use of the Cement Gun for Exterior Plastering

By A. E. Collins before the Institution of Municipal and County Engineers.

By reason of the shortage of men for exterior plastering, the cement gun has had to be introduced on housing work in Norwich with exceednigly satisfactory results. It consists of a steel uppter cone with a valve at its bottom resting on an upper tank, also with a valve at its bottom separating it from the lower tank, at the bottom of which is a feed wheel rotating in a horizontal plane, the peripheryof which consists of a series of pockets each of which is presented in sequence to the outlet nozzle leading to the delivery hose. A charge of ready mixed plastering material is placed in the upper cone, air under pressure in the upper tank is discharged by means of a cock, and the valve of the upper cone is opened permitting the charge to fall into the upper tank. Air is admitted to the upper tank, the valve at its bottom is opened and the plastering material falls into the lower tank, where the feed wheel carries it in charges, regulated by the size of the pockets, to the outlet nozzle,. Immediately over the pocket, which at the instant is opposite the discharge, is a nozzle so arranged as to form a shield and at the same time to injcet air, supplementing the pressure within the chamber and forcing the charge out of that particular pocket into the hose and along it to a discharge nozzle which may be 200 to 300 ft. distant. A smaller hose conveying water under pressure is also carried to the discharge nozzle. This nozzle is so arranged as to deliver a spray of water on to the plastering material as it issues therefrom; consequently, the cement is not damped until the instant it is being deposited upon the surface being plastered, with the result that there is no disturbance of the initial set.

Plastering materials are forced on to the surface at high presure and velocity, with the result that an extremely dense coating is constructed; I have found that with ordinary Portland cement the plastering becomes so hard in two days after deposit that it withstands the blow of the hammer as perfectly as similar plastering done by hand does after a week. The rapidity of the work is such that the exteriors of two ordinary cottages can be plastered per day where the work is straightforward.

I cannot yet give the cost as compared with hand plastering, but by reason of its density and watertightness it is worth more. Some may not like the irregular appearance of the resulting surface; personally I like it.

# Trunk Highways Suitable for Western Conditions

## Road Problems of the Prairie Provinces Are Essentially Different from Those of Older Localities Where Population is Dense and Traffic Heavy—Motor Truck Issue is Not Yet a Serious Factor

By C. W. DILL, Superintendent of Highways, Province of Saskatchewan, before the tenth general professional meeting of the Engineering Institute of Canada, held at Saskatoon on August 10-12.

The question of transportation on roads or main highways is one that has been of the utmost importance since the earliest days of settlement of our Western Provinces and, because of many reasons apparent to all those interested in our Western problems, the roads will continue to be of great importance.

In the earliest days the roads consisted of Indian trails and these were followed by the better marked, better located and better developed Hudson's Bay Company trails and waggon roads. Many of these later trails were so well located and served settlers in such a satisfactory manner as main traffic routes that they were surveyed, have become legal highways and still form important links in the provincial main roads systems.

Then came the rectangular method of surveys and the construction of the various railway lines crossing the provinces in generally diagonal routes, the combination of which has resulted in many difficult problems to be solved in the outlining of suitable main road connections which will serve the double purpose of serving settlers in the most advantageous manner as well as acting as links in a connected provincial or interprovincial main road system.

At a time when the long-standing national need for more and better highways is being substantially met by large appropriations from our federal and provincial governments one may well ask the question: What has made this large expenditure possible and in what terms will the dividends from the investment be expressed?"

Who pays for these highways for what purpose are they built and who benefits by them? On our Western Prairies these questions are of peculiar interest. In the Province of Saskatchewan we have a population of about 750,000, of which about 60 per cent. reside on the farm. The rural population is spread over a tremendous area, less than 2 per square mile of land, and we have almost 210,000 miles of road allowances. One can, therefore, readily realize the importance of good roads in the economic and social life of our prairie settlers.

### Not Concerned With Motor Truck Problem

The universal use of motor cars, of which there are some 70,000 in this province and some 55 per cent. of which are owned by farmers, for business, pleasure and social uses, also emphasizes the great need for improved highways. This general use of the automobile has stimulated road building in a way that probably nothing else has. We are not yet so concerned with the motor truck question, as until we are able to construct roads which can with certainty be used all through the year, their use will not become sufficiently general to become a problem to be dealt with.

Sufficient public interest has been aroused to create the feeling that good roads must be built if the country is to profit to the largest extent by the economic advantages of the cheapest and best methods of transportation along our highways; and if we are to have good roads, then road financing must be placed on a sound economic basis.

Our provincial main road system as outlined comprises three classes of roads as follows:

1. Main highway—a road used by all of the great majority of the people of a given district and terminating at an important point such as a trading centre or elevator.

2. Inter-urban highway—a road carrying traffic from one important point to another, located by the linking up of the main highways to each of these points.

3. Trunk highway—a road upon which may be located a number of important points, but which finally constitutes a road connecting cities or large towns.

The construction of these roads becomes a business arrangement, and under the best and most just conditions, the original investment for construction comes from the people as a whole, while the upkeep and maintenance of the roads is paid for by the vehicles that use them and in accordance with the amount of road wear each causes.

Every vehicle using the road should pay for the road wear which it causes. This fact is fully recognized by all those concerned with legislation pertaining to highway transportation and the maintenance of roads in condition to carry this transportation.

### Road Legislation

No satisfying law has yet been framed to accomplish this end, but the Roads Bureau at Washington has been conducting tests with a view to establishing a definite and workable basis for road conservation legislation. At the recent good roads convention in Halifax this matter was discussed in the interprovincial congress of provincial officials and the Honorable Mr. Veniot, minister of public works for New Brunswick, outlined the efforts being made in that province to control the use of the roads at certain times in the year and under certain weather conditions. Some of these restrictions are as follows:

1. An act limiting the weight of loads of 3,000 lbs., exclusive of the weight of the waggon or sleigh, between March 1st and May 15th. Special permits may be given under this act under bond providing for the repair or replacement of the road up to its previous

condition, and there are several penalties provided for its violation. After considerable objection being raised by the lumber and mining companies, the act has been accepted and the government has been highly commended for it.

2. A regulation was passed in the session of 1920-21 limiting truck loads to five tons for local trucks and to three and one-half tons for outside trucks. Fees and penalties are provided in this regulation. The annual fee for a two-ton truck is $134.00, made up as follows: ($10.00 for registration + fee for carrying capacity + fee for dead weight of truck).

3. A regulation providing that no truck can use any road during heavy rains or until the roads are dry and the patrolman has gone over them and given permission.

4. A regulation refusing to permit tractors to be used in hauling loads over the roads in the spring-time while automobiles cannot use the roads, while frost is coming out of the ground. There is no definite date fixed as the restriction is regulated by local conditions and the district road supervisor determines when this restriction is to be removed.

5. A regulation restricting empty motor trucks travelling at a speed greater than 12 miles per hour.

6. No motor vehicle is allowed to use a trailer, except by registration and the payment of special fees.

To those living in the West these regulations and restrictions may appear to be drastic and onerous; but to those of us who understand the difficulties of maintaining our roads up to a useful usable standard, at all times and during all seasons, and particularly the apathy and indifference of the average person in the matter of the upkeep of the roads, these regulations contain much of merit and could well be at least partially adopted so as reasonably to control the traffic using the roads and bring people to a sense of their responsibility and obligation in the preservation of the capital invested in the roads as well as the utility of them when the weather conditions are such that all use of the roads, except in case of real necessity, should be stopped.

### Uniform Traffic Regulation

Another important watter was discussed at the Halifax convention, viz.: uniform traffic regulations and the Honorable John Oliver, premier of British Columbia, advanced the following as worthy of consideration:

1. Speed of vehicles using the roads.

2. Load limits for various types of vehicles—which brings in the question of permissible amount of loading of vehicle to each inch width of type used.

3. Interchange of travel privileges in the various provinces, making it possible for motor truck and automobile owners to operate in other provinces than the one in which their license was secured, for certain periods.

4. Use of signs indicating railway crossings or some other specially dangerous local condition.

In connection with the question of methods of financing good roads, bonding, etc., the Honorable Mr. Henry, of Todmorden, Ontario, at Halifax, outlined the methods in vogue in the province of Ontario.

York county had started out by issuing debentures for 30-year periods, but it was found that new construction was necessary before the end of this time and the period is too long. It is now generally felt that a 20-year period for debenture issues should be the limit, as this is considered the maximum of road life even for permanent types of pavements.

For the ordinary types of earth, gravel and macadam roads, Mr. Henry advocated the pay-as-you-go system, as demands will increase with the years, and it is poor business to load up the future with accumulated debenture repayments. Permanent bridges and culverts should not be included in this pay-as-you-go method. He considers that all bond issues should be for reasonably short terms and be protected by sinking funds, etc., for retirement purposes.

Following the discussion on Mr. Henry's address this resolution was passed: "That bonds isued for the purpose of borrowing moneys for highway construction should not be for a period longer than a conservative estimate of the permanency of the intended construction justified."

In connection with the construction of a properly outlined highway system it is evident that this should be proceeded with only after careful investigation and selection of routes, the determination of the most suitable type of construction to be used and the adherence to a definite plan so as to ensure continuity of effort and so as to obtain the best results to the publics for the money and energy expended.

### Selection of Road Type

In the selection of the roads to be improved the first consideration is naturally that of service to the greatest possible number of people in the district. Following this are the questions of the natural physical conditions of the country through which the road will run and the nature of the materials available, at a reasonable cost, for the construction of the road.

The selection of the type of road to be built is the next consideration, and in most sections of our Western Provinces this resolves itself into a question of utility and relative cost. Naturally the question of selection carries with it a consideration of the traffic conditions and what the road is intended to stand up under. In the choice of type we must select that one which, in our best judgment, will carry the traffic that will pass over it with the least possible expense.

One difficulty we have to contend with is that, even in the United States, engineers have not yet evolved an inexpensive light type of road which will carry even ordinary farm traffic during all seasons and under all weather conditions without very serious deterioration and the need for almost constant expense for upkeep and maintenance.

Mr. Hirst, chief engineer of Wisconsin, speaking at the Good Roads convention in Winnipeg last year, said: "We have all kinds of engineers and expert advisers and people quite competent to built a standard hard-surfaced road, but we have only a small percentage of engineers who can design and built a road out of the material of the west-clay."

Types of roads are classified as earth roads, sand-clay, gravelled, macadam and concrete with or without a bituminous or other surface. In the selection of the road to be built the two main things to be considered are:

1. Economy of construction—not necessarily the cheapest type, but one that will carry the traffic at the

least possible expense of combined construction and maintenance charges.

2. To meet the demand of possible future development of traffic without a destruction of the whole of the capital invested in the road.

A. W. Campbell, M.E.I.C., Dominion Roads Commissioner at Ottawa, says:

"When well-crowned, well-dragged, well-drained and well-graded, an earth road, on a proper part of a system, is just as serviceable as a paved road, if it has traffic requirements consistent with its construction.

C. H. Moorefield, senior highway engineer of public roads and rural engineering of the United States Department of Agriculture, published a schedule of what each type of road would do, for the purpose of guiding in the selection of types of roads to earn federal aid, and here is his summary:

Earth Roads—will carry light volumes of all kinds of highway traffic.

Sand Clay Roads—will carry a moderate traffic of horse-drawn vehicles and light auto-traffic.

Gravel Roads—will carry heavy traffic of horse-drawn vehicles, light auto traffic and light traffic of auto trucks.

Waterbound Macadam Roads—will carry the same general class of traffic as gravel roads.

Surface-treated Macadam Roads—will carry heavy auto traffic and light traffic of heavy trucks.

Bituminous-surfaced Roads—will carry heavy auto traffic and moderate traffic of heavy trucks.

Concrete Roads—will carry the same general class of traffic as bituminous roads, but are capable of withstanding heavier traffic without injury.

Brick Roads—will carry the same general class of traffic as concrete.

In a paper read by A. Fraser, A.M.E.I.C., engineer, Department of Roads, Quebec, on earth, gravel, macadam and permanent roads, he divided construction items into permanent and non-permanent.

Permanent items include alignment, grades, widening, drainage, permanent culverts and bridges and foundations, and Mr. Fraser suggested that money invested in these items should be met from capital account on moderately long re-payment periods.

Non-permanent items include surface-treatments of various kinds, maintenance, etc.

On earth roads all work, except maintenance of surfaces and ditches, can be classed as permanent.

On gravel or macadam roads the permanent portion includes foundation and drainage work. In this connection Mr. Fraser does not recommend unnecessarily expensive preliminary drainage work, but prefers to deal with each special case when the need becomes apparent.

### Construction Features

In connection with the construction of roads the writer will not attempt to emphasize more than the need for constant attention to the following points:

1. As intimate a knowledge as possible of the conditions, for a period of years, which will effect the actual location of the road and the establishment of such grades as will render the road passable for traffic at all seasons of the year.

2. Very special attention to drainage, the success of which is probably five-sixths of the success of the road as a permanent means of travel.

3. The proper shaping of the road surface so as to encourage travel to spread over it rather than to follow along defined ruts, as is unfortunately so often the case and which soon renders a road dangerous for travel.

4. The placing and treatment of the surfacing material so as to give the greatest possible value in service and in the case of maintaining the surface up to a satisfactory standard.

On the types of roads possible throughout the Western Provinces the question of upkeep and maintenance is causing much more concern than the actual construction of roads. This is because of the great difficulty in awakening public opinion to a realization of the great need of preserving the capital invested as well as to the usefulness of the roads in maintaining them in a much better state of preservation.

The sparse population, the necessity of labor on the land during the short summer season and the comparative poverty of the rural municipalities, when one considers the great mileage of roads, 384 miles in each nine township municipality, to be cared for, all constitute difficulties to be overcome before the maintenance question can be given the prominence it deserves and must be given.

Road maintenance can be defined as the act of bringing a good road to and holding it in a state of efficiency, and a maintained road is a usable road and is of unlimited value to the public.

As a result of experience in most of the states of the Union the patrol system of maintenance has been found to be much the better method and, as a means of discovering and repairing defects before they have had a chance to become serious and of avoiding annoyance and inconvenience to the travelling public, has in a new way proven the worth of the old adage that "a stitch in time saves nine."

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## BOSTON ADOPTS STRAUSS TYPE OF BRIDGE

The city of Boston has selected the Strauss double-leaf, underneath counterweight type of bascule for the new highway and electric railway bridge over the south channel of the Mystic River, Chelsea street. The bascule spans will be two in number, placed side by side, having a span of 118 ft. 0 in. between trunions, one electric railway track, a 25 ft. roadway and one 5 ft. 6 in. sidewalk. In addition to the bascule spans, the project will include several fixed girder spans, concrete piers and abutments in deep water, a total sum of $800,000 having been appropriated for the entire work. F. F. Sullivan is Commissioner of Public Works and John D. Carty is Division Engineer of the Bridge and Ferry Division. It is expected that the entire project will be ready to advertise this fall.

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## R.A.I.C. TO MEET IN TORONTO

The 14th general annual assembly of the Royal Architectural Institute of Canada, which is allied with the Royal Institute of British Architects, will be held in Toronto this year on October 10-11 at the King Edward Hotel. Mr. David R. Brown is president and Mr. Alcide Chausse, Montreal, is honorary secretary.

# Basement Floors in Timber Mill Construction Buildings

## A Description of the Three Types of Floors Ordinarily Employed for Factory Service, viz., Monolithic Concrete, Wood on Coal Tar Concrete Base and Wood Blocks on Concrete Base

Information service issued by the National Lumber Manufacturers' Association

Basement floors in mill construction buildings are ordinarily of one of three types: (1) monolithic concrete; (2) wood flooring laid on a coal tar concrete base; (3) wood blocks on a concrete base. The type to be selected depends upon the requirments and the probable use of the basement. The floor is more than part of the structure; it is a factor which affects the efficiency of both worker and manufacturing process. Careful attentiion should therefore be given to a consideration of the proposed use.

### Concrete Floors.

Monolithic concrete floors are suitable for basements used mainly for storage. The sub-foundation for such a floor usually consists of a base of cinders or gravel about 6 inches to 12 inches deep. Tiis is covered with a layer of 1:2:4 portland cement concrete 4 inches to 6 inches thick and finished with a wearing coat of 1:2 mixture of cement and sand, usually from 1 inch to 2 inches thick. The finishing coat must be kept wet for at least ten days after laying.

Basements which extend below an adjacent water-level and where there is much quicksand, should have the concrete layer reinforced to take care of the stencil stresses produced by the resulting upward pressure. It is necessary to water-proof such a basement by some approved method.

### Wood Floors.

Basements to be used for light manufacturng purposes, or, as machine shops, and where the trucking is light should be made more habitable by the use of wood floors. A shop floor of this type is made by laying a wood wearing surface on a base consisting of coal tar concrete. Such a floor is made by first spreading a 4-inch layer of screened gravel or stone not larger than 2½ inches mixed with tar containing from 20 to 25 per cent of creosote oil. The tar is heated 200° F., and enough used so that the mixture will be compact when rolled. The sand and gravel should be well heated before the tar is added.

Often a 4 to 6-inch base of portland cement concrete is used, it should be given a coat of tar before the top course is laid. A layer of tar and sand mixed in the proportion of fifty or sixty gallons of tar to each yard of sand and heated to 225° F. is spread over the base to a depth of 1½ inches, and plank 3 inches thick is laid directly over this top coat while it is still warm and before it sets. The plank is then tamped into place, toe-nailed together, and a top or wearing floor laid on the plank.

### Wood Block Floors.

Wood blocks for floors may be used either treated or untreated, the choice depending on nature of occu- buildings or for any floor of buildings of masonry construction, as they may be placed on either a plank or concrete base.

### Creosoted Wood Block Floors.

Creosoted Wood block floors possess all the advantages, intensified, of the ordinary wood floor. In pancy, moisture conditions, and the necessity for great durability. This type of floor is an excellent one for a basement that is to be used for heavy manufacturing purposes wherever it is to be subjected to excessive wear from trucking. The application of wood blocks is not limited to basements of mill construction addition to having a resilient surface which means comfort for the worker and a minimum breakage of articles dropped upon it, a smooth surface that is not slippery, a material that does not retain extreme heat or cold, and a construction which allows easy change of piping, creosoted wood block floors absorb dust, are germless and have great durability. A floor of this type made of properly selected and treated lumber and laid in an approved method, should last twenty years or more.

In general creosoted wood block floors may be divided into two types:

(1) Those suitable for use in buildings which are always dry, as in most factories and warehouses.

(2) Those suitable for use in buildings which are alternatively dry and wet, caused by flushing etc., such as slaughter houses, and where excessive humidity prevails.

Most failures in floors of either type are caused by undue shrinkage or expansion of the blocks, which is probably the result of not antcipating the above conditions.

Blocks to be used in situations always dry or heated should be thoroughly air seasoned or even kiln dried before treatment and laid in the floor while absolutely dry. Thorough seasoning prevents excessive shrinkage. An empty cell treating process, with five to eight pounds of creosote oil per cubic foot, gives an excellent floor at moderate cost. Blocks can be laid with a close joint.

In the second case the floor is similar to creosoted wood block street paving. Green or partially seasoned timber is desirable, although dry lumber may be used if treated with live steam prior to the creosoting. In the preservative treatment a heavier absorpion of oil is often advisable.

### Filler.

A plastic and waterproof material, such as an approved pitch filler, should be used on each joint. Expansion points, 1-inch wide, should be provided arounds walls, columns, and machine bases.

The foundation of the blocks should be of concrete if possible. As in a concrete floor it is advisable to spread as the sub-foundation a thoroughly compacted layer of cinders or gravel about 6 to 12 inches deep. A 4-inch layer of portland cement concrete forms the main foundation. A cushion consisting of a ½in-inch layer of sand and cement grout is spread on top of the concrete. This should be smoothed until level, so as to give an even bearing for the blocks.

The so-called "bituminous paint" method of construction consists of a layer of concrete with an even surface, painted with a thin bituminous paint coat not exceedng ⅛-inch thick, and the blocks laid directly on this paint coat. In this case the object of the paint coat is not to act as a cushion but to seal the bottom of the blocks.

Wood blocks when used for upper floors of mill construction buildings should be placed on two layers of paper laid in pitch. The blocks should be bedded in hot pitch and the joints filled with the same material.

### Durability of Creosoted Wood Block Floors.

The durability of pavements constructed of creosoted wood blocks is an established fact. Their use in floors is a more recent development, but enough examples are on record to indicate their durable qualities.

Mr. C. H. Teesdale, chairman of the Committee on Wood Block Paving, American Wood Preservers' Association, submitted a paper at the 1916 annual meeting which included the results of a questionaire giving a record of one hundred and sixty floors. Three of these floors were laid prior to 1909 and about seventy-five per cent. in 1912 or later. While these floors had not been in service long enough to give conclusive evidence, they caused users in seventy-seven cases to report that durability was one of the advantages. Evidently the wear has been negligible. More over, quoting Mr. Teesdale, "The records of one hundred and sixty floors given in this report indicate that serious trouble has developed in a very low percentage of cases."

Mr. L. T. Ericson stated two years later in a paper read before the American Wood Preservers' association, "Creosoted wood block floors seldom fail from decay. If properly manufactured and treated and properly installed they should wear indefinitely, but when the floors do eventually fail it should be from wear alone."

Creosoted wood blocks when exposed to fire on their wearing surface only are fire resistant to a marked degree. The Railway Age Gazette, December 17, 1915, quotes a report of the burning of the Philadelphia & Reading Pier No 36 at South Wharves, October, 1914, as follows: "This fire was so hot that a large portion of structural steel was fused, the whole pier shed was destroyed and the greater portion of the burnt wreckage was thrown on the wood block floor. After the removal of the debris, it was found that the wood blocks, which had been subjected directly to the flames, were only charred ⅛ to ¼ inch, but where the fused structural steel had come into contact with the wood blocks, they were charred from ¾ inch to 1 inch deep."

### Patented Wood Block Floors.

There are several patented blocks on the market which often may be used to advantage. They possess commendable points in addition to those of the usual wood block floors. The manufacturers state that the shape and method of manufacture of one of their styles gives a floor that is very little affected by heat or moisture; and the shape of another style gives a floor in which the expansion is absorbed by the component blocks. The manufacturers of another system fasten the blocks to a board base, thus permitting the rapid installation by panels or sections.

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# Transportation and Communication in the Northland

By R. C. Wallace, Commissioner of Northern Manitoba, at the 10th general professional meeting of the E. I. C.

In territory where distances are great and settlement sparse, the problems of transportation and communication ever lie across the path of progress. Without reasonably cheap freight charges, development is uneconomical. Without the means of sending messages to the outside world, family life cannot be successfully maintained. The period of railway expansion in the West has passed, and for many years it will be difficult to induce the railway corporations or the government to build northwards, except where exceptionally important industrial centres will be formed. Transportation will be provided over motor truck roads and narrow gauge light railways more extensively than in the past, and for many purposes, gold mining camps, for instance, such transportation is adequate.

The onus of providing such transportation facilities will rest more heavily on the provincial governments in the future than it has done in the past, no matter whether the resources are handed over to the prairie provinces now or twenty years hence. The responsibility is provincial for the very fundamental reason that if not assumed by the provinces it will not be assumed at all.

Doubtless, as far as passenger traffic is concerned, the hydroplane will to a considerable extent replace the canoe in the North. It does not seem probable, however, that the air service will be in a position to quote a freight rate for many long years that will compete with a light railway or motor truck service, except under exceptional conditions.

The simplest and least costly means of communication in northern territory will in all probability prove to be the wireless telephone. When the system has been reasonably perfected, trained operators will not be needed at outlying points where such units are established, as is the case with the wireless telegraph. With an ordinary unit operated by a 3 h.p. oil engine, the radius of transmission from 40-foot high aerials, which can be set up in a couple of hours, is seventy miles; the whole outfit can be transported in freighter canoes. There are difficulties due to "static" charges which must yet be eliminated before the system can be always relied on; and a high power wireless plant operating in the district will always make conversation impossible. Two units are being installed in northern Manitoba territory during the present summer, which will be the forerunners, if the units prove successful, of a system that will link up the important posts in that territory. From the point of view of medical services alone, apart from business and administrative requirements, such a system would prove a godsend to the pioneers who, with their families, are endeavoring to open up the northern hinterland.

Aug 27, 1921

# The Need for Town Planning

## Proper Development of Land and Absence of Exploitation Are Fundamental to Municipal Prosperity—Want of a Planning Scheme is Responsible for Housing Troubles—Fallacy of High Buildings

By THOMAS ADAMS, Town Planning Adviser, Commission of Conservation, Ottawa.

The success of a city or town depends upon its manufactures and trade, and the average factors that contribute most to that success are health and contentment of the citizens, the transportation and other facilities for transit of passengers and distribution of goods, the supply of power, and the absence of excessive burdens of taxation. All these things are dependent,, in turn, on the proper development of the land and the absence of exploitation for purely speculative purposes of those who use it. The health and contentment of the individual are not so much determined by the amount of wages he receives as by the amount of goods he can purchase with his wages. In a community where proper living standards exist he will have to pay from one-fourth to one-fifth of his income for shelter. If for that payment he can get a good home, with a pleasant environment, proper sanitary conditions and convenient means of transit, he will, or should be satisfied. But in the average large city he has to be content, invariably, with a crowded or insanitary dwelling. If in a suburban area, where a good house is available at a reasonable price or rent, he will probably have to put up with bad sanitary conditions and lack of facilities for travel. Urban land is not planned and sub-divided to aid the worker to get a convenient and healthy home, nor to enable the city to obtain an economic system of development, but primarily to yield profit to the subdivider, without regard to other results, either to the purchaser or to the city.

### Where Responsibility Rests.

The responsibility for the wasteful and uneconomic system which has been followed must rest with those who have the power to end or vary the system in so far as it is defective. That power does not rest with the private builder or real estate operator any more than with the house owner or tenant. Each of these parties is a victim of the system, even if utilizing it for private ends. The only power that can operate to improve housing, transportation, industrial development and other things that constitute the problems of the modern city, is vested in the government of the city. Therefore, it is the city council, subject to the terms of the Municipal Act of the Province, that has the responsibility for existing conditions, or for their improvement. For instance, if land is sub-divided 20 or 50 years before it is wanted for building, with consequent waste of capital in development, lessening of agricultural production near the city, etc., the discredit of that must rest with the council that could impose conditions to prevent excessive sub-divisions. If, in the city, there are thousands of vacant lots in the suburbs, with miles of pavements, sewers and water mains, producing no revenue to any one, then the city that has no plan to secure closer development and prevent wasteful scattering of buildings is to blame.

Transportation, which affects both the facilities needed to develop industries and those needed to convey workers to and from their places of employment, can be conveniently arranged in the well placed city, where wide streets are provided and height of buildings is controlled so as to avoid congestion. Enormous expense has been incurred in getting rid of evils caused by haphazard building and bad sub-division of land, coupled with lack of planning the street railway system on any definite principle as a community service.

### Town Planning Can Remedy Bad Conditions.

The cost of land for industrial purposes is often excessive, and this high cost is aggravated by the system of assessment of land for which the city is responsible. Land values are excessive when they do not permit of stable conditions of investment in the land and the improvements placed upon it. A bad feature is that land is not planned so as to give adequate facilities for industries. Valuable land, suitable for industrial location, is occupied by buildings that have no need for frontage on railways, canals and main highways. Those who wish to establish industries in the city or suburbs have often to purchase land that has been sub-divided in small lots and sold to numerous purchasers, some of them perhaps in remote parts of the world. The person proposing to start an industry has to be put to great nconvenience in acquiring such lots, and this may cause him to give up the idea of coming near or into the city. In some cases he may have to scrap valuable pavements and other public services which are constructed to suit a kind of development entirely different from that which the industry requires.

Town planning can accomplish much in the way of improving the older parts of existing cities, by the regulation of building heights, densities and character of use of lands and buildings. Perhaps the bigger problem however, and certainly in many respects the more urgent one, is the planning of areas, in course of development or undeveloped, in the suburbs around the city. Among the fallacies that sometimes are regarded as truisims by business men, and that have prevented them from condemning the existings conditions—notwithstanding that they recognize the evil results that accrue from these conditions—is the theory that land speculation is harmless in any forms now practised and that high buildings are an indication of enterprise rightly directed.

### Land Speculation and Housing.

Many people who are interested in property do not seem to realize the damage caused by injurious forms of speculation in land and in building construction. One fallacy is that complete liberty to the individual to use his land as he likes is good for business, as well as a sound democratic principle. As a matter of truth it is neither, especially in the case of land situate in a city where the interests of one person are so much interwoven with the interests of others. Whatever restraint there is on liberty is should be the minimum necessary to prevent the injury of one person by another, but freedom to use property as one wills is a form of anarchy and not of democracy. With regard to the effect of this freedom on property values, probably tens of millions of dollars are wasted in Canada every year or two as a result of the injury caused to buildings by the unneccessary destruction of the agreeable character of their surroundings.

### Stability of Investment of Property.

In the improvement of land sub-division and the control of building development by town planning, we have to seek the necessary means to secure stability of investment in property. Many cases could be mentioned where the value of residences is seriously reduced as a result of buildings with a high fire hazard being erected in their proximity, the owners therefore being called upon to pay increased insurance premiums.

Then there are the common cases, where residential streets are lowered in value as the result of the erection of stores in the wrong place. Properties affected in value in this way represent a loss to the owners, frequently to the mortgagors and also to the city.

A statement frequently made is that land reform is the root of housing reform. This is true, but in a wider sense than most people seem to understand. It is not the monopoly in land nor the price of land that makes the land question most important in connection with housing. The relative cost of the site to the cost of building is not, on the average, a serious factor. It is the indirect results that follow a system of land speculation and scattered sub-division of land that create the real problem. In other words, it is the want of a town planning scheme, with regulations to control land subdivision and building development, so as to secure the greatest economy and convenience that makes the land a question of fundamental importance in connection wth housing.

### High Buildings Financially Unsound.

Another fallacy is that high buildings need to be permitted because they pay or because they facilitate business. They do not pay, upon the whole, and, beyond a certain point, they destroy the facilities for business. As a city grows in population the need for street transportation increases more rapidly than the growth of population. It is computed that a city of 600,000 inhabitants needs twice the carrying facilities of a city of 400,000. If you congest cities in the centre you destroy the means of rapid horizontal transportation. It is not the distance that a man lives from his place of employment that matters, so much as the time that it takes him to get to and from it. The time spent by people getting from congested central areas of cities like Toronto is many times greater than would be necessary to cover double the distance under a rapid means of communication.

In regard to financial results, the high building does not pay directly, in the long run, and it is a serious loss to the community by reason of the congestion it produces. In time it becomes necessary for the city to provide underground means of transportation and other services at enormous expenditure. At a meeting of the National Association of Building Owners and Managers—surely a very practical body—Mr. Edwin S. Jewell, of Omaha, who is manager of the City National Bank Building of that city, declared that buildings under ten storeys were more profitable than higher buildings, because of the saving that would be made on the tremendous cost of foundation and elevator equipment. He pointed out that among other things, a six or eight-storey building was more marketable than a higher building when the character ot a district changed; that the money put into costly foundations and sub-basements of high buildings, elevators etc., would be sufficient to errect a complete four to six-storey building on the same piece of ground, thus putting capital to a more useful purpose. By spreading the business district over a wider area it would lessen congestion and carry business nearer to residents. On the question of cost, Mr. Jewell asserted that a lower building can be built for 14 cents per cubic foot cheaper than a tall building. In a study of revenues from a large number of high office buildings in more than 50 cities, he found that the receipts and expenditures from 143 buildings, in 1919, showed an average income of about $1.41 per square foot, whereas it would require $2.64 per square foot to make the investment realize six per cent. Thus the case against high buildings is not on aesthetic grounds but on the grounds that they do not yield adequate profits to the owners and that they produce serious financial losses to the cities in which they are erected.

### Assessment and Taxation.

The extent to which the finance of the city and its problems of land development or town planning overlap is not usually appreciated. Indeed, the average man thinks of town planning in terms of increasing expenditures on fanciful improvements instead of in terms of regulation of the growth of the city in the interests of economy. Methods of assessing land should have regard to benefits received by the owners of the land and to ability to pay out of the revenues derived from the proper use of land. Abuse of the land by congestion of buildings, or non-use by monopolists, should be prevented. The present assessment methods encourage rather than retard land speculation. The speculator does not usually own the land long enough to find himself liable for taxes. He passes on the liability to the purchaser for use when he can. Many never have more than a nominal equity in the land.

It will be no solution of the problem of excessive taxation of real property, where it exists, to transfer the burden to income and personal property. There may be cases where equity demands that this should be done, but the solution is to be found by planning the city so that scattered and wasteful development will be avoided, and the cost of government thereby reduced.

### Objects of Town Planning.

Whatever protection town planning will afford to the amenities of life in our growing cities, its chief case will always rest on the economic basis it provides for a sounder and more prosperous form of city development. It is perhaps necessary to remind the reader that the object of town planning, as described in the legislation advocated by the Commission of Conservation, is, first, the securing of the best economic use of the land; second, the controlling of the height, use and density of building on each acre or lot; third, the securing of proper sanitary conditions and adequate provision for air space around buildings, and fourth, amenity and convenience in connection with the planning, laying out, classification and use of land for any purpose. In the legislation and local action needed to promote these general objects the private interest has to be safeguarded as well as the public interest. A great deal of work is involved in preparing and carrying out schemes, because of the depth and complexity of the issues involved. Government aid and leadership are needed from the provinces; provincial governments have the greatest power and therefore the greatest responsibility to remedy conditions. The most hopeful thing about the conditions in some of the Canadian cities is that they are so serious that it will soon become imperative to make an effort to provide a permanent and stable solution.

### Conclusion.

Canada has been built up by the attractions it has thrown open to the peoples of the world, in the form of cheap land, securities of possession of property and freedom of citizenship. These are the things that have made Canada what it is to-day; and their possession are pledges that will bind the people to the country. But the evidence appears to indicate that we are now reversing the process needed for sustaining these pledges. The costly and wasteful system of land development in many cities is retarding in improvement in sanitary conditions, preventing the acquisition of sites for homes at a reasonable cost, and creating excessive burdens of local taxation. On the fringes ot some cities the the equity of the owners of land is being destroyed and large areas of unprofitable land are being taken over by the cities. The dwellings erected on the dear lots are afforded no adequate protection from deterioration by control of their surroundings. Meanwhile the land speculator calmly awaits the return of periods of "boom" and opportunities to exploit new settlers, while the system of taxation does not reach his gains although it mounts up as a result of his methods.

The burden of making local improvements should be transferred from the cities and the users of land to those who seek to profit by its sale as speculators. If this were done there would be fewer ventures in land gambling, less waste in costly development, closer settlement and fewer absentee owners. Before land in the neighbourhood of cities is sold in lots for dwellings it should be provided with a supply of good water, means of drainage and sewage disposal, and some form of pavement at the expense of the vendor, and be in conformity with a general plan of the city, approved by the city council. It is only those who direct the government of affairs in the province or in the city, and not those who enjoy profits from the absence of good government, who can provide the remedy and give the pledges needed to revive stability of investment in property and promote an enduring and prosperous citizenship.

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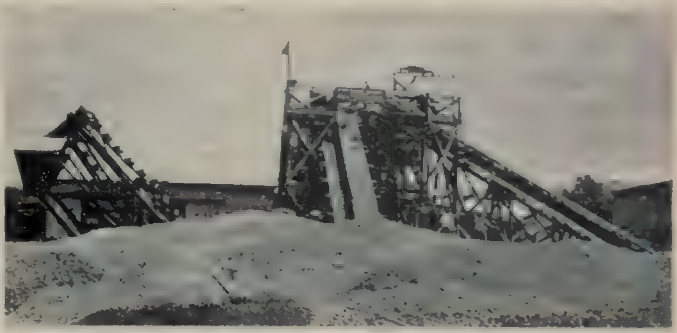
## Conveyors Are Features of Mixing Plant on Concrete Road Job

A novel method of getting materials to the mixer is the distinguishing feature of a central mixing plant operated by the Henry W. Horst Company on the Mt. Vernon road near Cedar Rapids, Iowa, U. S. A. Two belt conveyors are used to feed a bin above the mixer. The bin has a compartment for sand and another for gravel, below which is a smaller bin which is used for proportioning the sand, gravel and cement. One conveyor handles sand and the other gravel.

Material is shipped in, unloaded in Cedar Rapids and brought to the job in 3-yard trucks. The trucks dump directly into the hoppers of the conveyors. Each hopper has a capacity of six cubic yards. Additional material is furnished the conveyors from the storage piles built in the spring before work began, the sand storage pile being built near the hopper of the sand conveyor and the gravel near the other.

Two methods are employed to get the sand and gravel from the storage piles. The sand was scraped by means of a scraper pulled by a Fordson tractor. A Barber-Green loader and a Ford truck with a dump body brought the gravel to the conveyor hopper. The scraper method had to be abandoned when the sand near the conveyor hopper was all used. Then the bucket loader had to load alternately from the sand and gravel piles.

Operation of the plant is as follows: The conveyors keep the storage bin above the mixer well filled with sand and gravel. This bin has two compartments. one for sand and one for gravel. Below it is a proportioning bin immediately above the mixer. The cement man fills this bin with the proper amounts of sand, gravel and cement, and the mixer engineer trips the proportioned batch into the mixer. Ford trucks with Lee bodies haul the wet mix an average of two miles to the subgrade where the finishing touches are put on with a Lakewood tamper.


A concrete mixing plant in which conveyors are a feature.

The bin is kept full at all times, thus ensuring a supply of material when some accident interferes with the supply. The belt conveyors are a surer means of getting material to the mixer and they can be operated at much greater economy and capacity than trucks. The bin and conveyor system eliminates most of the arguments against the central mixing plant idea.

The bin system was developed by the Horst Company last year, two derricks being used to get the material to the bin. The conveyors have been able to deliver greater capacity and cost less to operate than did the derricks. An ordinary 4-sack building mixer is used, elevated so that it can easily discharge into the Ford trucks.

Last year the conveyors were used handling sacks of cement on government concrete work at Savanna, Illinois. They were the Barber-Greene standardized portable conveyors and were 39′ long with 18″ belt. By adding 36′ of standard sections, carried in stock at the Barber-Green plant, and the necessary belt, each portable machine was converted into a 75′ permanent conveyor without delay. The same 15 h.p. LeRoi engines had ample power to operate the longer belts.

# Opportunity for Young Men in Big Business

### Head of the Westinghouse Company Demonstrates How Hard Work Brings Results—The Example of Samuel Insull

Preparing oneself for opportunities to be ready when they come was the theme of the address of General Guy E. Tripp, chairman of the board of directors, Westinghouse Electric & Manufacturing Company, at the commencement exercises of the Westinghouse Technical Night School a few weeks ago. He told how one man prominent in the electrical industry, Samuel Insull, took advantage of learning more by doing more work, and what resulted from his effort. General Tripp said further:

"Here, then, we have a well-conducted college for men and women which equips them to go as far as their natural capabilities will permit them to go. It opens the door of opportunity and that is all that any college can do; but it is equally true with you as with the graduating class in any other college, that you have not finished your education; you have, in fact, just begun it.

"I know this is a time-worn phrase and that it is less necessary to remind this graduating class of it than it would be if I were speaking to a class in any of our large colleges. In that case I should feel like stating it over and over again, because I have seen many graduates of universities who, believing they were possessed of all knowledge, had to endure a period of discouragement and disillusionment before they fully accepted the truth of that same time-worn phrase.

"You probably have clearer ideas of the relation of your education to your life's work than does the average college graduate. With him or her an end has come; a period of life has been closed. He is told that he is now educated and that the time has come for him to begin his fight for success, therefore, most of these young men believe that they must fight, they don't know what, but nevertheless they must fight something or somebody in order to achieve success.

#### The Fight for Success.

"Now the only thing which they can and must fight is themselves. They must, in fact, begin the fight which you have already made while you have been acquiring your education. In that respect they begin where you leave off.

"They must learn self-restraint, which is an entirely different kind of restraint than that which is imposed by college rules.

"They must supply their own energy, which is not the kind which is displayed under pressure from the college faculty.

"They must learn that success is never attained by mere wishing and only very rarely by chance, but that it nearly always comes through hard work.

"Of course, there are many college men who have learned these lessons just as you have and in the same manner, nevertheless the greater number pass through the experience to which I have referred.

"You have learned all these things even before you entered here or you would not have entered, therefore, you have an advantage which ought to save you some valuable time.

"Nowhere in the world are there such opportunities for men of this stamp as there are in this country. In this country the highest positions in life are absolutely open to everyone, and, as a matter of fact, they are now occupied to a very great extent by men of humble beginnings. Not only is this country one of opportunity, but now is the time when men of understanding and clean thinking are needed as never before.

"There have never been presented so many tremendous problems calling for a correct solution as there are at this moment, and no one should be so immersed in his own personal matters as to fail to give intelligent consideration to his duties to society. You will not fulfil your duties as citizens unless you enlist yourselves to some extent in the public service on the constructive side.

"The forces of destruction and obstruction are constantly with us, and always will be, because they enlist in their ranks all the discontented ones, all those who find it difficult or obnoxious to submit to that self-restraint and discipline which are necessary to maintain an orderly social condition in a country like ours.

"It is much easier to tear down something than to build it up. There is more excitement to be had in destroying than in creating, and excitement makes a strong appeal to young people; but, looking at it solely from the selfish personal standpoint, no one achieves real success in following a destructive or obstructive policy. Some little brief notoriety may result, but when the returns are all in and the account has been balanced, a man of ability who has devoted his life in this direction finds failure and disappointment at the end.

#### Constructive Work.

"If there are wrongs in society which cannot be cured by constructive means, it is probably better to endure them than to pull down some social institution and very likely create a still greater wrong.

"I am optimistic enough to believe that all our fundamental difficulties can and will be lessened through constructive work, and I am sure that you will do your part in the years to come. You must do it because you are young and your life is before you, and upon the young rests the responsibility. Those of us who are getting along in years envy you. We envy you, your youth and opportunity. We envy the enthusiasm and optimism of youth. Almost every older man in a responsible position is searching earnestly for a young man to whom he can transfer some of his burdens and responsibilities—a young man in whom he has confidence and whom he thinks will conserve and carry on the work already started; and, when a young man begins to rise above his fellows and shows that he has the simple fundamental qualities which I have before referred to, there is more than one bidder for his services.

#### Opportunity for Young Men.

"There never was a time when such a young man with loyal instincts had so many opportunities as at the present time.

"I have spent many hours on different occasions in conference with others trying to select young men for responsible positions both within my own company and outside. It is more difficult to find such men than you imagine.

"In the first place, while we know that there are many of them, we unfortunately do not know who they are. They have not yet attracted wide enough attention to be known beyond a comparatively small circle.

"Then, again, there are too many who have got a wrong start, a wrong attitude of mind, whose daily actions are based solely upon selfish considerations. However able such a young man may be, those who are responsible for the selections for important positions fear to run the risk that he would change his outlook upon life and become loyal to a trust for others; there much ability is wasted in unsuccessful and ultimately discontented men.

"However, these are all generalities and it doesn't do to generalize too much. When all is said, the fact remains that men usually select themselves for higher positions and I can best illustrate that by reading to you from an interview by Mr. Samuel Insull of Chicago, who is not only the dean of the electric light and power industry, but is also one of the outstanding successful men of America. Mr. Insull began his business life in London and he describes his own experience as follows:

" 'I had answered a "blind" advertisement, and, as a result, had secured a position as secretary to Mr. Edison's business representative in London. I had come into the business without any knowledge of either the technical or the commercial side of it.

" 'What prepared me rather quickly for a better place, and attracted the attention and support necessary to get it, were two pieces of work outside of my regular duties.

### Chances for Advancement.

" 'The first chance came only a few weeks after I had taken the job, when my chief sailed for the United States and left me behind. There was not much to be done in the office, and I might have had most of my time free. In fact, it was expected that I would. But thanks to an immense curiosity about the business, I didn't; I stayed in the office and read, and re-read, every document I could lay my hands on.

" 'When the chief came back I was able to supply him with information on current affairs and even on things which had occurred before I came with the business. And I could relieve him of more work than he had expected I could. It had all come about in the simplest possible way, that would have been open to anyone; yet it made a considerable impression on him.

" 'The second outside task—of course, there were other smaller ones in between—came a year or so later. Mr. Edison's technical representative in London was getting out a report on electrical developments in England and on the Continent. He wanted a stenographer to work with him evenings, for perhaps two months, and he asked me if I couldn't find one for him.

### Hard Work Brought Results.

" 'By this time I had become fairly well informed on the commercial side of the business, but on the technical side I was still pretty ignorant. It struck me that here was my opportunity to brush up on that side, and I volunteered for the job.

" 'It was hard work. It kept me busy often until midnight, on top of unusually active days, as it turned out. But it brought quick results.

" 'This is they way they developed. The technical man went to New York with his finished report. While he was away he wanted someone in the London office to keep posted on certain European properties in which he was interested, and to send him weekly reports. I was chosen to do it. I was chosen simply because of my familiarity with the properties, and with the requirements of this technical man, which I had gained from my evening sessions with him as a stenographer.

" 'In the ordinary course, the weekly reports were shown by the technical man to Mr. Edison. There was nothing elaborate or difficult about them. They were simple compilations of certain data, which my work with the technical man had made it easy for me to prepare. But they showed a familiarity with the properties, and with other details of the business, that Mr. Edison liked. It happened that he himself was needing a secretary at the time. He asked the technical man about me, and then sent for me.

" 'You see how directly one of the unnecessary tasks brought the opportunity; how the two of them together had prepared me for it; and how impossible the opportunity would have been but for my undertaking those tasks, no matter what sort of natural ability I might have had. As a matter of fact, the real opportunity was not the call from Mr. Edison, but the chance at those bits of outside study and work. And there are similar opportunities opening up from every job.

" 'I found them again when I became Mr. Edison's secretary, although it was not so easy to take advantage of them. The actual requirements of the work were stiffer. The night I landed in New York—I got there about six in the evening—I called on Mr. Edison immediately, and worked straight through with him until four in the morning.

" 'That was unusual; but even under ordinary conditions there was a good deal of overtime work. Mr. Edison was as likely to be in his laboratory at midnight as at midday. Often the most convenient time for him to attend to his business affairs was after he had finished in the laboratory. It was not uncommon for me to spend the day in the office in New York and then go down to his home at Menlo Park, in New Jersey, for a session with him at almost any hour of the night.

" 'In spite of these long hours on many days, there were still opportunities to learn more about the business than I was actually required to know. Mr. Edison helped to make these opportunities, as any good executive would. He used to stay after his own work was finished and explained things to me.

" 'Gradually I was able to relieve him more and more of business matters. At first I only handled his correspondence, with his help. Then I handled it mostly without his help, and certain other business matters as well. Finally I was put in full charge of all his business interests.

" 'So much for my own experience. The experience of all the principal executives in our organization has been fundamentally the same.' "

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## STANDARD SUPPLY CO. OPEN OFFICE

The Standard Supply Company have opened sales offices at 390 Notre Dame St. W., Montreal. They will act as distributors for the Canadian Roofing Mfg. Co., Ltd., Windsor, and for the Hamilton Tar & Ammonia Company, Ltd. The Montreal office is under the management of Mr. E. D. Bellefeuille.

# Water Power Resources of the Prairie Provinces

## The Possibilities for Electrical Development in Manitoba, Saskatchewan and Alberta—Development of the Resources of the West Depends on a Supply of Cheap Power

By C. H. Attwood, District Chief Engineer, Dominion Water Powers Branch, Winnipeg.

(Before the tenth general professional meeting of the E. I. C., Saskatoon, Sask.)

While the central-southern portion of the Prairie Provinces is practically without water power resources, Eastern Manitoba, Western Alberta and the northern areas of all three provinces are abundantly supplied. In Manitoba, the Winnipeg River, due to its proximity to Winnipeg, is at present the most important power river in the province. When fully regulated, this river will have a capacity of 500,000 h.p. all within roughly 70 miles of Winnipeg; of this over 100,000 h.p. is already developed and transmitted to Winnipeg and district. Other water powers amounting to nearly 2,800,000 h.p. are to be found, principally on the Nelson, Churchill and Saskatchewan Rivers.

The total power possibilities of Manitoba at known sites or drops as estimated is 3,200,000 h.p., the details of which are summarized in table No. 1.

In Saskatchewan extensive water power investigations have been made along the Saskatchewan, Churchill, Reindeer and Sturgeonweir Rivers, with particular reference to the Flin Flon mining district. These investigations have been supplemented by reconnaissance studies throughout the province.

The southern portion of the province does not possess water power resources suitable for ready engineering development or favorable economic exploitation. The central and northern portions, however, are well supplied with great water power reserves. Among the more important power rivers in this section might be listed the Churchill, Reindeer and Black. Numerous important and easily developed power sites are available on these and other rivers throughout this section of Saskatchewan and development only awaits existence of a market demand and of adequate transportation facilities.

**Table No. 1,—Summary of Undeveloped Water Power in Manitoba**

| River | Horse Power at 80% Efficiency | | | Remarks |
|---|---|---|---|---|
| | Estimated Minimum Develop. | Estimated Maximum Develop. | Dependable with Storage | |
| Assiniboine | 685 | 2,817 | | |
| Berens | 11,450 | 18,570 | 13,305 | |
| Big Black | 5,140 | 8,339 | | |
| Bloodvein | 4,100 | 6,660 | | |
| Burntwood | 9,060 | 27,185 | 20,200 | |
| Churchill | 325,500 | 467,600 | | |
| Dauphin | 16,960 | 19,540 | 23,450 | |
| Fairford | 2,635 | 3,030 | 3,640 | |
| Grass | 5,130 | 15,380 | | |
| Hayes | 7,600 | 22,800 | | |
| Manigotagan | 780 | 1,600 | 2,900 | |
| Minnedosa | 113 | 640 | | |
| Mossy | [illegible] | 790 | 1,000 | |
| Nelson | 2,443,300 | 3,948,000 | | |
| Pigeon | 24,880 | 40,400 | 28,000 | |
| Poplar | 3,885 | 6,285 | | |
| Red | 1,060 | 4,400 | | |
| Saskatchewan | 58,600 | 197,445 | 147,276 | |
| Shell | 20 | 52 | | |
| Wanipigow | 400 | 1,100 | | |
| Waterhen | 5,680 | 6,540 | 7,840 | |
| Winnipeg | 249,790 | 435,000 | 334,000 | |
| Total | 3,177,049 | 5,234,173 | | |

The total possibilities of Saskatchewan at known sites and drops is some 570,000 h.p., the details of which are summarized in table No. 2.

**Table No. 2,—Summary of Available Water Power in Saskatchewan.**

This represents the estimated total power at sites concerning which some record is available.

| River | Horse-power at 80% Efficiency. | | | Remarks |
|---|---|---|---|---|
| | Estimated Minimum Development. | Estimated Maximum Development. | Dependable with Storage | |
| Beaver | 785 | 2,300 | | |
| Black | 72,550 | 217,902 | | |
| Churchill | 311,150 | 582,415 | | |
| Foster | 906 | 2,728 | | |
| Geikie | 2,450 | 7,359 | | |
| Madjatik | 575 | 1,732 | | |
| Rapid | 5,927 | 15,750 | | |
| Reindeer | 93,070 | 106,560 | | |
| N.Saskatchewan | 3,439 | 14,880 | | |
| Saskatchewan | 72,240 | 350,750 | | |
| Sturgeonweir | 5,660 | 9,895 | (1) 34,800 | (1) With storage and Churchill diversion. |
| Total | 568,761 | 1,312,071 | | |

### Powers in Alberta

Alberta brings us to a coal producing province, but this has not prevented the development of approximately 33,000 h.p., principally on the Bow River, to supply Calgary. Detailed power and storage investigations have been made in Alberta on the larger rivers, while a great amount of data relating to the smaller streams have been collected. The largest resources are to be found in the northern part of the province, for of the 466,000 h.p. credited to Alberta, three-fifths is estimated as existing on the Slave, Peace and Athabaska Rivers, which offer excellent opportunities for development as soon as a market demand develops and transportation facilities become available.

As stated, the total power possibilities of Alberta at known sites or drops is estimated at 466,000 h.p., the details of which are summarized in table No. 3.

### Administration

The water powers of the Prairie Provinces are administered under regulations pursuant to the Dominion water Power Act, 1919. These regulations provide for the exploitation of the water power resources under full government control of rates, rentals, etc., in such a way as will ensure the power needs of the provinces being met to the best advantage in the public interest. The object of the regulations is to prevent unwise or premature development of water power and provide for the permanent retention in the Crown of the ownership and control of the power project. Concessions are only made for limited periods of bona fide applicants capable of prosecuting the development to a successful issue.

In the administration of the water power resources, the policy of the department is in brief: to encourage desirable development of water power resources; to discourage and prevent the initiation and development of uneconomic and wasteful projects; to ensure that each site developed shall utilize or provide for the future utilization of the maximum available power; to ensure that river systems are developed along comprehensive lines wherein each unit is a component link in a system; to ensure adequate storage measures in the interests of all powers affected; to prevent unnecessary and costly duplication of expenditures on the part of competing plants; to protect the public from inadvisable power schemes and ill-designed plants and dams; to safeguard the public from monopolistic control by regulation and periodical revision of rates; to see to the early carrying into effect of agreements issued by the department for the development of power; to compel the development of existing plants to their limit when the market demands, and to the fullest conservation of the power resources of the West.

When it is realized that most of the larger streams are either interprovincial or international it becomes apparent that some of the most important features of the above policy cannot be carried out by solely provincial control. Dominion administration means protection from extra provincial domination, it means relief from international interference, it assures continuity of fundamental investigatory effort by means of general water resource studies, hydrometric surveys, power and storage studies and appropriate research, all absolutely necessary for the proper understanding of the exceedingly complex issues involved in the best use for all purposes of water and power. It will assure the fairest and the most fearless administration and the establishment of a scheme of water power regulation as free as it is possible to make administration from undue political patronage or worse.

**Table No. 3,—Summary of Undeveloped Water Power in Alberta.**

This represents the estimated total power at sites concerning which some record is available.

| River | Horse power at 80% Efficiency. | | | Remarks |
|---|---|---|---|---|
| | Estimated minimum development. | Estimated maximum development. | Dependable with Storage | |
| Athabaska | 97,795 | 333,550 | | |
| Bow | 14,852 | 37,319 | (1)<br>29,085 | (1)<br>24 hour power. |
| Brazeau | 2,360 | 7,150 | | |
| Cascade | 818 | 1,090 | 1,090 | |
| Castle | 1,134 | 4,370 | | |
| Clearwater | 3,925 | 11,813 | | |
| Crowsnets | 276 | 656 | | |
| Elbow | 3,400 | 10,580 | 8,640 | |
| Oldman | 478 | 1,820 | 1,270 | |
| Peace | 19,000 | 63,500 | | |
| Red Deer | 1,616 | 10,130 | | |
| N.Saskatchewan | 4,700 | 25,825 | (2)<br>10,800 | (2)<br>24 hour power. |
| Spray | 1,532 | 3,443 | 7,386 | |
| Slave | 313,500 | 599,000 | | |
| Snake Indian (Stony) | 680 | 2,000 | | |
| Sturgeon | 68 | 300 | | |
| Total | 466,134 | 1,114,446 | | |

## Market for Power

It is not the writer's intention to discuss at length the market for power in the three prairie provinces. Attention may, however, be drawn to the principal phases of the possible future demand. The steady influx of population to the cities, to the rural districts and throughout the northern areas of the three provinces is creating a heavy and growing demand for manufactured goods and will inevitably result in a rapidly increasing demand for cheap and dependable power. The rapidly growing market for industrial products offers possibilities to municipalities in industrial lines which municipal authorities are quick to realize. Undoubtedly the industral activity will be centred chiefly in those cities where cheap power and good transportation facilities can be obtained.

The water powers of the Winnipeg and the Bow are already utilized in considerable measure in supplying the domestic and industrial lighting and power requirements of Winnipeg and Calgary and immediately contiguous municipalities. The rapid growth of these centres offers market for constantly increasing blocks of power. The distribution of Winnipeg River power has already been extended to Portage la Prairie, Carman and Morden. Further extension in this district will doubtless take place as the market demand warrants, while the availability of power will in itself tend to more rapidly increase the market for its use. Similar opportunities for the extension of electrical distribution from central power stations offer in other parts of the West and the future power demands of the pariries can no doubt be met by a power policy which will provide for the development of all available water powers in connection with great steam plants located at or near the mines from which they draw their fuel supplies and pour the product of the hydro and steam plants into the transmission systems for distribution. On the other hand, comprehensive provincial-wide electrical transmission system designed to serve all sections, irrespective of the market demand, cannot be economically considered under the present conditions of scattered population.

**Table No. 4,— Summary of Developed Water Power in the Prairie Provinces.**

| River | Company or Owner | Location of Plant | Head in feet | Turbine or water wheel horse power installed |
|---|---|---|---|---|
| Bow | Calgary Power Co. | Kananaskis Falls | 58 | 11,600 |
| Bow | Calgary Power Co. | Horseshoe Falls | 70 | 20,000 |
| Bow | Calgary Water Power Co. | Calgary | 10 | 780 |
| Bow | Canadian Pacific Ry. | Bassano | 30 | 135 |
| Lake Louise Creek | Canadian Pacific Ry. | Lake Louise | 115 | 300 |
| Blindman | Municipality of Lacombe | Blackfalds | 24 | 200 |
| Winnipeg | City of Winnipeg | Point du Bois | 45 | 67,100 |
| Winnipeg | Winnipeg Electric Railway Co. | Pinawa Channel | 40 | 40,000 |
| Minnedosa | Canada Gas & Electric Corp. | Near Brandon | 33 | 900 |
| Minnedosa | Minnedosa Power Co. | Minnedosa | 20 | 450 |
| | | | Total | 141,465 |

## Industrial Development Depends on Water Powers

While agriculture is the great basic industry of the Prairie Provinces, they also possess unique resources of mine and forest which up to the present have been scarcely realized. The utilization of these resources with the consequent industrial centres which will be created offers a field of development which will exercise possibly as great an influence on the future of this region as has the settlement of the prairies in the past, and which will place the prosperity of the entire territory on a broader and firmer basis. In the exploitation of these resources the water powers of the north and east will play a dominant part, ensuring as they do an inexhaustible supply of cheap power.

Already great activity is in evidence in various districts looking to the utilization of water power as an aid to the development of other natural resources. The dependable data which has been systematically secured with respect to these powers is available in the department to all interested in legitimate projects of exploitation.

In providing for the power needs of the three provinces a proper co-ordination of the water and fuel resources is essential. The provinces are fortunate in that there are vast fuel reserves available in districts where there is little or no water power. It is profitable to keep in mind that under many circumstances fuel-fired steam plants can successfully compete with hydro-electric power. In the interest of conserving these fuel resources it is, however, desirable that the use of water power be encouraged wherever economically feasible. Co-ordination in the investigation and exploitation of these two resources will ensure that the fuel and power needs of the three provinces will be properly met and provided for.

## TORONTO HARBOR AS A FUTURE OCEAN PORT.

The recent inspection of the harbor developments by the firm of Barber, Wynne-Roberts & Seymour, Consulting Engineers, Toronto upon the occasion of their annual picnic is interesting in so far as it was made particularly in the interests of several of the firm's clients in the British Isles and United States, who are considering establishing branch manufacturies in Canada and are conducting their investigations of conditions here through this firm. Speaking on the subject, one of the members of the firm emphasized the keen interest of outside firms in Canada as a base for export trade and gave it as his opinion that Canadian firms were possibly not keenly alive to the possibilities of the situaton, nor sufficiently familiar with the work of the Harbor Commission in preparing for the day when the St. Lawrence Deep Waterways would be an established fact.

The information was brought out that all piers and docks will furnish a present navigable depth of 24 ft. and provision is made for an ultimate depth of 30 feet by dredging, as soon as the demands of navigation require it. In all their work of harbor development the commissioners have kept before them the certainty that at some future date the St. Lawrence deep water way must be constructed, and in order that Toronto should benefit to its fullest extent by this improved navigation and be prepared to accommodate the ocean carriers, which may in the near future be trading to ports on the Great Lakes, the commissioners in their development are providing every modern facility for the economic and rapid unloading and loading of vessel cargoes both in the industrial districts and along the commercial waterfront of the inner harbor, together with adequate accomodation for passengers and the co-ordination of rail and water transportation, all of which will be in readiness to take care of the first ocean vessels to navigate the St. Lawrence deep waterway. In other words, Toronto will be prepared to accommodate 100 vessels of 5000 tons and upwards with equipment necessary to complete their unloading in 24 hours.

In connection with the recreation development, Toronto is the first city that has ever combined in its plans of harbor improvements industrial and commercial development. The recreational development consists of the reclamation of 900 acres of park lands at the Eastern and Western extremities of the city and at Toronto island. At Sunnyside in the west end, a board walk 24 feet in with and 1½ miles long has been constructed and likewise 1½ miles of the westerly portion of the boulevard driveway. This driveway is 50 feet feet in width and when completed will extend along the lake front from the Humber River to Bathurst Street, thence across the western entrance to the Harbor by means of a movable bridge, across the Island to the Eastern gap, which will also be crossed by another movable bridge and thence along the Lake Front to Woodbine Avenue, where it will connect with the driveway being built around the City by the Corporation which will again connect with the boulevard driveway at the Humber River. The total length of this driveway will be 45 miles. A bathing pavilion to accommodate 5,000 people an hour is under construction at Sunnyside. The Sunnyside Pavilion, a restaurant with terraced tea gardens has been built and is in operation. Tenders are now being received by the Commission for the establishment of amusements in this section. An idea of the popularity of the Sunnyside Beach may be realized by the fact that the beach in its unfiinished condition accommodated during the month of July an average of 15,000 to 18,000 bathers a day.

These facts should have a bearing upon the future, not only of Toronto industries, but also those throughout the Province. Ontario is strewn with industrail wrecks, responsibility for which must to some extent be laid at the door of insuffıcent and unintellgent business and engineering investigation. The fact that foreign firms find that they can conduct their investgations satisfactorily through local channels would seem to indicate Canadian industries have been overlooking opportunities at their own door. This condition has no doubt been due to keen competition for industries among the smaller municipalities and the customary reticence among professional men in advertising their qualifications along these lines.

## CIVIC ARCHITECT FOR HAMILTON, ONT.

Alderman McKay, of Hamilton recently brought to the attention of the city council the large amount of money that is expended each year by the city on acchitect's fees, and suggested the appointment of a civic architect. Council is looking into the matter more thoroughly.

## GOTFREDSON JOYCE CORPORATION, LTD.

Gotfredson Joyce Corporation, Limited, have opened a sales office at 144 Bleury St., Montreal, which will be under the management of Mr. G. L. Ellis, who was for several years connected with the White Company. Mr. R. G. Perry is also on the sales force.

## CONTRACT FOR SARNIA, ONT., PAVEMENT

The contract for the extension of the London Road pavement in Sarnia, Ont., has been let to Reid & Somers of Guelph. W. V. Taylor is city engineer.

## Mainly Constructional

**East and West—From Coast to Coast**

It is reported the Shale Brick Company of Canada, at Cooksville, Ont., closed down recently. The plant employed 160 men.

The Union of Columbia Municipalities and the British Columbia Good Roads League will hold a joint convention at Port Alberni, B. C., commencing the 30th of this month.

Notice appears in a recent number of the Ontario Gazette of the formation of a Branch of the McClintic-Mars hall Products Company, with office at Toronto, capital not to exceed $30,000. This firm will construct buildings, bridges, eac. and manufacture structural materials.

The property known as Leslie Nurseries, situated on Queen St. East, Toronto, has been sold by the owners, Canadian Pacific Railway, to a local syndicate and will be cut up into building lots. The property comprises 25.61 acres and is very favourably situated for house building.

The annual outing of the members and staff of the engineering firm of Barber, Wynne Roberts & Seymour, of Toronto, held recently, took the form of a tour of the harbor development work in the Harbor Commission's yacht, "Bethalma." A program of sports at Centre Island concluded the outing.

The Essex Border Utilities Commission has decided to proceed with the plan for a district town planning development. Mr. Morris Knowles, former engineer of the Commission, put in considerable work on this plan, at a cost of $7.000. It is estimated additional expenditure of $4,000. will be required for the completion of the plan.

The Town Planning Division of the Commission of Conservation of Ottawa, will be transferred to the National Parks Branch of the Department of the Interior. The work will proceed along the same lines as before, however, and under the same supervision, Mr. Thomas Adams and assistants W. D. Cromarty and Alfred Buckley, M. A.

No time is being lost in making a start on the reconstruction of the devasted section of the town of Aylmer, P. Q., destroyed recently in the large fire. Most of the buildings under construction at the present time are of a temporary nature to accomodate the carrying on of business during the clearing of the debris, after which buildings of a permanent type will be erected.

Engineer Wardley, in charge of the construction of the Banff-Windermere Highway, in Alberta, received word recently from Ottawa that the sum of $50,000 was being advanced to finance further work on the above road. Construction therefore will proceed and it is expected that by the end of the year 23 miles of the highway will be completed, leaving 20 miles of the road to be built in 1922.

The Civic Improvement League of Montreal and the Town Planning Institute of Canada are planning to hold a congress and exhibition shortly to further the project of an urban plan for the city of Montreal. The associations have made application for the use of the Commercial High School for the holding of this congress and the officials are making every effort to get the congress under way at the earliest possible opportunity.

Of the $20,000,000 Federal appropriation for good roads, made available by the Dominion overnment last year the provinces to date have undertaken projects which would entitle them to assistance to the extent of only $7,660,604. The Federal Government pays its 40 per cent. of the estimated costs only when the work is completed and its inspectors and auditors approve the work and the accounts. Up to August 1 the total amount paid was $1,051,773.

Fifty third-year students of the Faculty of Applied Science and Engineering University of Toronto, left the city last Saturday for the University's summer survey camp at Gull Lake, in Haliburton county, Ont. This summer instruction course lasts for six weeks. Another party of mining engineering students will go to the camp on September 3 for a four-week courses. These ractical courses will be under the supervision of Professors W. M. Treadgold and S. R. Cerar, D.L.S., and Banting and Melson.

### Personal

County Engineer McGeorge, of Kent County, Ont., returned recently to Chatham after an enjoyable ten-day holiday in Muskoka.

Messrs. Hutton & Souter, architects of Hamilton, Ont., have been appointed to supervise the construction of the new building to be erected at the Guelph Collegiate Institute, Guelph, Ont.

Messrs. Bowden and Wooton, engineers of the International Joint Waterways Commission, accompanied by several members of the commission from Toronto and Kingston, left the latter city recently on an inspection tour ofthe proposed St. Lawrence River deep waterway route, looking over the propesed sites of dams and canals between Kingston and Montreal.

W. E. Hobbs, surveyor for the Manitoba Good Roads, Board, has been appointed Controller of Town Planning for Manitoba, attached to the Municipal Commissioner's department. His duties will consist in supervising the planning and regulation of use and development of land. Mr. Hobbs was, previous to three years service overseas, a member of the firms of Bayne & Hobbs, land surveyors and civil engineers. Upon his return he entered the service of the Manitoba Good Roads Board.

### Obituary

Mr. Wm. Allan, at one time member of the contracting firm of Allen and Fleming, at Ottawa, Ont., died recently in that city. Mr. Allen directed the construction of the locks at the entrance of the Sault Ste. Marie canal also several other important contracting projcets on the St. Lawrence River.

Mr. John M. Kilburn, vice-president of the Canada Cement Company and prominent citizen of Owen Sound, Ont, died recently in that city after an illness of several months. Deceased was born at Smith's Falls, Ont., and took up residence in Owen Sound at an early age. When he was 20 years of age he started in business at Invermay, Ont., and after ten years in business, took up the study of the law. After being admitted to the bar, he opened an office in Invermay and remained there until 1885, when he returned to Owen Sound and continued in practice, first as head of the firm of Kilbourn & Bishop, and later in partnership with one of his sons, in the firm of Kilbourn & Kilbourne. He was a keen business man and seeing the possibilities connected with the growth of the Portland cement industry he became interested in the Owen Sound Portland ement Company, and later took a prominent part in forming the companies which built cement mills at Lakefield, Ont., Calgary, Alta., and Montreal, P. Q. On the formation of the Canada Cement Company, he became prominently and actively identiefld with it, holding the office of vice-president.

# CONSTRUCTIONAL ACTIVITY

## Period of August 17 to August 23, 1921

*Dominion Wide Service Exclusive to "Contract Record & Engineering Review"*

### Waterworks, Sewerage and Roadways

**Bromptonville, Que.**

Work will be commenced shortly on gravelling section of Levis-Sherbrooke Highway.

**Edmonton, Alta.**

Tenders endorsed "Tender for Headworks" will be received until Sept. 17th by Irrigation Council, Lethbridge, Alta. Project comprises about 12,000 cu. yds. of concrete masonry, plain and reinforced, excavation and other incidental work, erection of headworks machinery and construction of 75 M., F.B.M. of timber trestle work in connection with the construction of the headworks, spillway and crossing of Old Man River, being part of the irrigation system of the Lethbridge Northern Irrigation District. Forms of tender, bond, contract, plans and specifications may be obtained from the Irrigation Council, Edmonton or Lethbridge, on deposit of $20.00.

**L'Avenir, Que.**

Work will be commenced shortly on gravelling section of Richmond St. Fir du Lac Road. A Paradis, Engr., Roads Dept., Parl. Bldgs., Que.

**London, Ont.**

S. Baker, City Clerk, will recive tenders until Aug. 29th for construction of sewage pumping station house costing $50,000. Plans with H. A. Brazier, Engr.

**Montreal, Que.**

City Council plans construction of sewers, asphalt paving, etc., on several streets.

**Ottawa, Ont.**

Construction of watermain on Wellington St. at cost of $135,000 is contemplated by Council. A. F. Macallum, Commr. of Works.

**Regina, Sask.**

Hett & Sibbald, Prince Albert, have generafl contract for road work at Shellbrook, Sask., for Dept. of Highways, Prov. Govt.

**Sherbrooke, Que.**

City will construct tile sewer on Argyle St. at cost of $10,000.

City Council plans construction of concrete and brick sewer on Blouin Lane at cost of $15,000.

City will construct asphalt pavement on Brooks St. at cost of $14,000.

City Council are constructing asphalt paving and granite block paving at cost of $72,000 on three streets.

Trunk sewer is being constructed on Bowen Ave. by City at cost of $22,500.

City Council plan expenditure of $100,000 on paving next year.

Concrete sidewalks are being constructed by City at cost of $18,000.

**Simcoe, Ont.**

W. C. McCall, Town Clerk, will receive tenders until Sept. 2nd for construction of storm and sanitary sewers, curb, gutter, Tarvia and macadam pavement. Plans with Engr., G. R. Marston.

**Ste. Victoire, Que.**

Municipality is gravelling section of Levis-Sherbrooke Highway at cost of $10,000.

**St. Catharines, Ont.**

Construction of waterworks system is contemplated by Grantham Twp. Council. F. N. Rutherford Engr., 24 Queen St., St. Catharines.

**Toronto, Ont.**

F. Barber Engr., 40 Jarvis St., Toronto, has plans and will receive tenders until Sept. 10th for construction of concrete culverts for Etobicoke Twp. Council.

**Warwick, Que.**

Municipality is gravelling one mile section of Levis-Sherbrooke Highway at cost of $10,000.

#### CONTRACTS AWARDED

**Damascus, Ont.**

Geo. E. Hay, Damascus, has general contract for construction of drain for Town.

**Guysboro, N.S.**

Landry & Stewart, Boylston St., Guysboro, have general contract for construction of gravel road for Prov. Highways Board.

**Halifax, N.S.**

General contract for waterbound macadam road for Prov. Highways Bd. is awarded to Terminal Construction Co., Roy Bldg., Halifax.

**Ioco, B.C.**

George Woodward has general contract at $11,000 for improvements to streets for Ioco Townsite Development Co.

**London, Ont.**

Utilities Commrs. plan construction of extension to waterworks system. Ohio Well Drilling Co., Massilon, Ohio, will drill test wells and, if satisfactory results are obtained, E. V. Buchanan, Mgr. of Cmsn., will prepare plans for connecting wells with supply.

**Moncton, N.B.**

City will construct watermains and awarded contract for pipe to Summer Co., 635 Main St.

**St. Mary's, Ont.**

Council awarded contracts for cement work and asphalt work for pavement costing $25,000 to Curran & Briggs, St. Mary's, and Warren Bituminous Paving Co., 54 University Ave., Toronto.

**Regina, Sask.**

Dept. of Highways, Prov. Govt., awarded general contract for highway construction costing $19,446 to Roasa & Wikstrand, Saskatoon.

Dept. of Highways, Prov. Govt., awarded general contract for road work from Wapella to Broadview, Sask., to Gibbs Bros., Lumsden, Sask., at $23,347.50.

**Thorold, Ont.**

Contract for sewer on one street for Town is awarded to Peter Damizzio.

**Wingham, Ont.**

General contract for construction of concrete pavement for Town is placed with W. C. Brennan Contracting Co., Melrose Ave., Hamilton.

### Railroads, Bridges and Wharves

**Doucet, Que.**

A. F. Stewart, Moncton, N.B., Chief Engr. St. Maurice Division, C. N. Rlys., has plans and will receive tenders until Sept. 7th for construction of Coffee River bridge. Plans also with Chief Engr., Toronto, Ont.; Dist. Engr., Quebec, Que.; Div. Engr., Tunnel Terminals, Montreal, Que. Accepted cheque for $4,000 must accompany each tender.

**Luceville, Que.**

A. F. Stewart, Moncton, N.B., Chief Engr. Eastern Lines, C. N. Rlys., has plans and will receive tenders until Sept. 6th for erection of station. Plans also with Engrs. at Quebec and Montreal.

**Merlin, Ont.**

M. R. Farquharson, Merlin, Clerk Tilbury East Twp. Council, has plans and will receive tenders until Aug. 30th for construction of concrete bridge. Plans also with Engr., Geo. A. McCubbin, 135 King St., Chatham, Ont.

**New Glasgow, N.S.**

R. C. Desrochers, Secy. Dept. Pub. Works, Dom. Govt., Ottawa, has plans and will receive tenders until Sept. 7th for repairs to wharf. Plans also with Dist. Engr., Halifax, N.S., and Post Office, New Glasgow.

**Stratford, Ont.**

Construction of reinforced concrete bridge is contemplated by City Council. A. B. Manson, Engr.

**Thurso, Que.**

Construction of bridge at cost of $15,000 is contemplated by Town. F. Frappier, Secy.-Treas.

#### CONTRACTS AWARDED

**Dartmouth, N.S.**

General contract for repairs to wharf and cribwork for Prov. Govt., Dept. Works and Mines, is placed with McNab Construction Co., care of Dept.

**Halifax, N.S.**

Gorman & Peckham, Roy Bldg., Halifax, have general contract for paving for C. N. Rlys.

**Prince George, B.C.**

P. W. Graham, Moose Jaw, Sask., has general contract erecting station at cost of $50,000 for C. N. Rlys.

**Prince Rupert, B.C.**

General contract for erection of station costing $40,000 for C. N. Rlys. is awarded to P. W. Graham, Moose Jaw, Sask.

ESTABLISHED 1886

Contract Record and Engineering Review

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## *Continuity of Service*

In the world of business there is probably no term that has come into more justifiable prominence than the single word, "Service." We have all come to realize that no article we can buy is trouble-proof. Accidents will happen to the best. Under these circumstances, the best article is looked upon almost universally as the one that carries with it the surest guarantee of adequate service.

It is not necessary to quote examples. We see them on every hand. The former standard on which we purchased articles of practically every description was "Quality." To-day it is "Quality—plus Service." Formerly the function of the manufacturer was to turn out his product, sell it and forget it, to-day he not only manufactures and sells as before, but, in addition, he watches over, and guarantees, satisfactory performance The new point of view has revolutionized business making for much greater efficiency all around and much greater cordiality of feeling between buyer and seller.

Incidentally, we may be pardoned for mentioning the continuity of service given our customer-readers by the Contract Record during the trying weeks between June 1 and the present time. On June 1 our linotype operators, our compositors and our press men, thinking to entirely destroy one of our most important assets—service—by leaving us in the lurch, walked out in a body. But it did'nt work. Every Wednesday, as usual, in its usual form, the "Contract Record" has gone out from this office —and it will continue to do so.

Through all this struggle—there is no use pretending it has been easy—our readers have been kept advised, as usual, of construction happenings and general building conditions. Our advertisers have been enabled, as usual, to deliver their messages to their customers. In a word we have been doing our level best to live up to our ideal of fulfilling to the letter the contract we enter into with our readers when we accept their subscriptions.

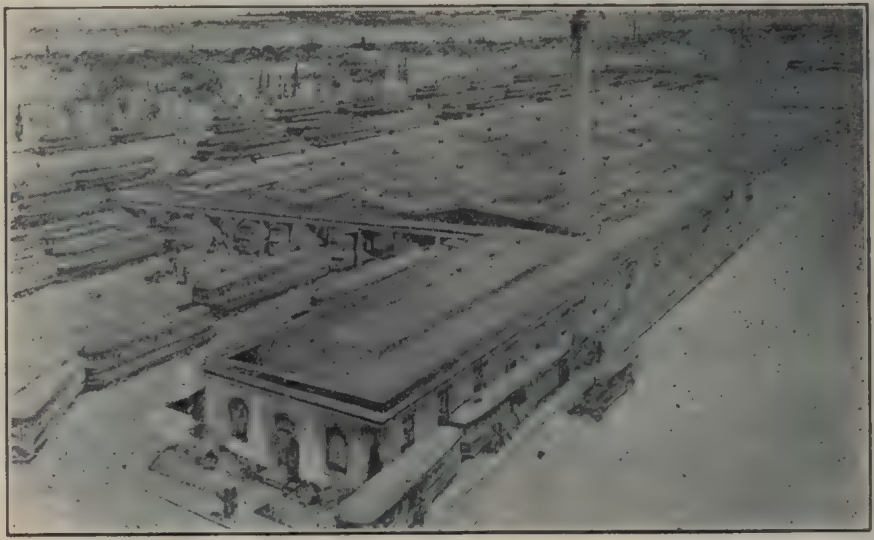
We should also like to take this opportunity of voicing our sincere appreciation of the attitude of our readers towards the evident weak spots in our publication during the past three months. Without exception we have had the most generous co-operation the most kindly consideration. This quite as much as our determination to resist the unreasonable demands of the union has made it possible for us to carry on Our thanks will be a redoubled effort to continue and to improve our service.

## *Large Water Storage Project*

In connection with its plans for the reclamation of its semi-arid states, the Brazilian federal government has retained Dwight P. Robinson & Company, Incorporated, engineers and constructors, of New York, to supervise a large amount of engineering and construction work. This work, which is located in the states of Ceara and Parahyba, will include the construction of five large dams, involving nearly a million cubic yards of concrete, to create storage reservoirs, some of which are to be larger than any artificial reservoirs existing elsewhere. The work is to be conducted under the direction of the Brazilian government and in its ultimate importance and economic value it is comparable to the irrigation work carried on since 1903 by the United States Government.

In these semi-arid states of Brazil there is an average rainfall of about 30 inches, which, if properly distributed as to time and volume, would make, even under the tropical sun, a sufficient supply of moisture to produce moderate crops. The climate, however, consists of a dry season, extending from May to December, and a rainy season lasting from January to April or thereabouts. Practically all of the rainfall occurs during the rainy season months when, if the precipitation falls in heavy rains, the soil is saturated, the springs are renewed and the rivers are in flood. In the dry years, however, the rainfall, although aggregating as much as the average year, may be precipitated largely in thin showers which, under a tropical sun, are quickly evaporated, with the result that the soil does not become well moistened and the rivers carry little, if any, run-off. Severe droughts result, which reduce the inhabitants of this section to a condition of starvation. It is to remedy this situation that this reclamation program has been undertaken.

The region to be benefitted, lying in latitude 4° to 8° south of the equator, will have climatic possibilities similar to southern Arizona and California, or the irrigated section of the west coast of Mexico. The streams which drain the region are of large volume and will furnish ample supply for reservoirs. The products of the country include cotton, sugar, skins, medicinal products, various kinds of palms and other nuts for the production of vegetable oils, citrous fruits and other products of tropical and sub-tropical agriculture.



A perspective of the street car shed extensions which the Toronto Transportation Commission is erecting on St. Clair Ave., Toronto.

# New Car Sheds for the Toronto Transportation Commission

## St. Clair Avenue Barns Being Extended to Accommodate 157 Cars —Additions Comprise Three Concrete Sheds with Offices and Repair Department—Details of Design

The present St. Clair Avenue car houses, Toronto, consist of two buildings, one erected in 1913, the other in 1916, each building being two hundred feet long by forty-two feet wide, with three tracks in each unit, housing in all 18 cars. These buildings are located at the north end of a property bounded by Benson Avenue on the north, Christie Street on the west and Wychwood Avenue on the east, with an area of 3¾ acres. An area of one acre in the southwest corner has been purchased, which squares off the site and provides accommodation for the additional cars which will operate from this division.

By the rearranged plan approximately one-third of the cars will be inside and two-thirds stored outside in the yard, the total accommodation being 50 cars inside and 107 cars outside.

The extensions to the present buildings consist of two sheds to the south, 230 feet long, and 44 feet 6 inches wide, each containing three tracks at 13-foot centres. On the north another section will be built 326 feet long and 44 feet 6 inches wide, containing offices, trainmen's recreation rooms, lavatories, locker rooms, stores, boiler room and a two-track repair bay.

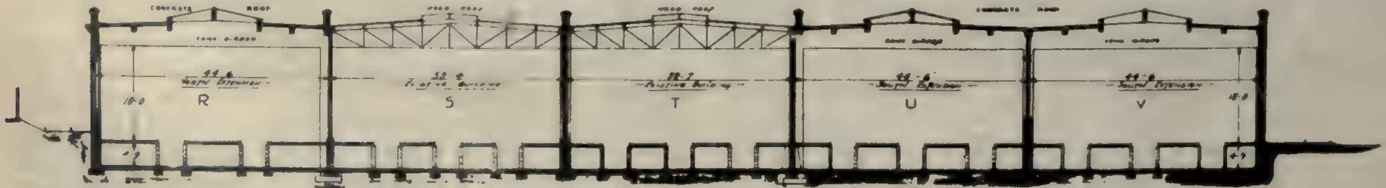
All three new buildings will be of reinforced concrete construction, with brick and tile walls. Concrete trusses span across each bay supported on concrete columns, leaving curtain walls with no superimposed load.

Under each track a pit runs the entire length of the building. These pits are lighted and heated, and all of fireproof construction.

The heating is a hot-air plenum system. The boiler room is equipped with a low pressure steam boiler, with forced draft and stoker feed. Two fans circulate the air which passes through the vento heaters, then along the main concrete ducts, runnng under the pits. Secondary tile pipes run the length of the buildings, carrying the air along under the pits.

The repair section to the north will have a wood block floor, and one repair track will be equipped with hoisting machinery to raise the cars from the trucks. Wheel grinders will also be installed and other smaller equipment for carrying out minor repairs.

The whole group of buildings, both old and new, will be sprinklered throughout and a 40,000-gallon tank erected to supplement the city pressure.



Cross-section of car barns, showing extensions of concrete construction.

The storage sheds proper will be open at both ends, and each track bay equipped with rolling steel doors raised and lowered by individual motors.

Construction work has been started and the operation should be completed by December at an approximate cost of $220,000.

# Engineers of the West Hold Successful Convention

## Engineering Problems of Western Canada Discussed at the Well-Attended Tenth General Professional Meeting of the E. I. C., Held at Saskatoon on August 10-12

The annual Western professional meeting of the Engineering Institute of Canada, held at Saskatoon on August 10th to 12th, inclusive, under the auspices of the Saskatoon branch of the Institute, was the best attended and most successful Western convention yet held. Delegates from each of the four Western provinces were in attendance to the number of about 150. Business started promptly on schedule time and was continued throughout the three days in strict accordance with the programme. The papers presented dealt with important professional matters, each attracting intense interest and creating considerable discussion, in which a large number of delegates took part.

The session was opened with an address of welcome by Dr. G. L. Ling, Dean of the College of Arts and Science of the University of Saskatchewan, and acting president of the university. Dr. Ling was followed by an address of welcome by Dr. A. Young, mayor of Saskatoon, on behalf of the city.

### Speechmaking by Means of the Audion

An interesting feature of the opening session was an address by his Honor J. H. Newlands, the Lieutenant-Governor, by means of the audion. His Honor, who spoke from Regina, enjoyed the unique distinction of being the first person in Canada to address an audience in another city by means of an audion; his voice could be heard distinctly in all parts of the room where the meeting was held. He spoke of the important engineering problems which would be discussed at this gathering of the leading engineers of the Western provinces and representatives from the Eastern points, and stated that he believed the public would benefit greatly as a result. His address contained a warm note of welcome for the assembled engineers.

A telegram from J. M. R. Fairbairn, M.E.I.C., Montreal, the president of the Institute, stating his inability to attend the convention owing to sickness was received by Fraser S. Keith, secretary of the Institute. Mr. Fairbairn extended his heartiest wishes for the success of the meeting and stated that he hoped to come West in the near future and visit the various branches of the Institute.

The following resolution was passed to be sent to Mr. Fairbairn: "We, the Western members of the Engineering Institute, assembled at the Western professional meeting at Saskatoon, regret exceedingly that President J. M. R. Fairbairn is unavoidably absent due to ill-health, and in extending sincere wishes for a speedy recovery are looking forward to an opportunity of meeting him at the various branches at an early date."

G. W. Craig, M.E.I.C., city engineer of Calgary, one of the oldest councillors of the Institute, presided over the meeting in the absence of the vice-presidents.

### Trunk Highway Deevlopment

C. W. Dill, M.E.I.C., superintendent of highways, province of Saskatchewan, read a very interesting paper on the development of trunk highways as affecting the Western provinces. The paper appeared in our last issue. Mr. Dill was followed by H. S. Carpenter, A.M.E.I.C., deputy minister of highways, province of Saskatchewan, who presented the report of the committee on standard specifications for highways. A lengthy discussion followed, led by M. L. Lyons, A.M.E.I.C., chief engineer Good Roads Board, Manitoba, and J. D. Robertson, A.M.E.I.C., of the department of public works, Alberta.

Professor G. M. Williams, A.M.E.I.C., of the University of Saskatchewan, gave a paper on "Effect of Alkali on Concrete," which was a brief review and summary of the conclusions reached by various authorities who have studied the deterioration of concrete by alkali salts in Canada and the United States during the past 15 or 20 years. The paper was well illustrated by lantern slides showing the results of numerous tests during recent years, and the effect of alkali action on various building and engineering structures. Professor Williams' paper was followed by a very interesting discussion led by A. S. Dawson, M.E.I.C., chief engineer, department of natural resources, C.P.R., Calgary, and J. N. Finlayson, M.E.I.C., of the University of Manitoba. R. S. Parker A.M.E.I.C., department of telephones, province of Saskatchewan, gave an interesting paper on the principles, construction, and use of the audion. The paper was fully illustrated by lantern slides and actual details of the apparatus. During the discussion which followed considerable conversation was carried on between the audience and persons in Regina and other parts of the province.

### Variety of Papers

The second day's sessions were occupied with the reading and discussion of the following papers:

"Water Supply and Irrigation Scheme as Affecting the Three Prairie Provinces," by G. N. Houston, M.E.I.C., secretary of the Irrigation Council, province of Alberta. Discussion led by A. J. McPherson, A.M.E.I.C., chairman, Water Supply Commission, province of Saskatchewan.

"Coal Fields of the Four Western Provinces—Briquetting of Lignite and Fuel Economy," by R. De L. French, M.E.I.C., engineer, Lignite Utilizations Board. Discussion led by Wm. Pearce, M.E.I.C., department of natural resources, C.P.R., Calgary, and Major-General R. G. E. Leckie, C.M.G., A.M.E.I.G., Vancouver.

"Economics and Engineering Features of the Manitoba Transmission System," by J. Rocchetti, M.E.I.C., chief engineer, Manitoba Power Commission.

"Water Powers of the Prairie Provinces," by C. H. Attwood, A.M.E.I.C., district engineer, Dominion Water Powers Branch, Winnipeg.

"Northern Territory in Western Canada—Its Development and its Problems," by Dr. R. C. Wallace, Commissioner of Northern Manitoba, The Pas. Discussion led by Lieut.-Col. A. C. Garner, D.S.O., M.E.I.C., chief surveyor, land titles offices, province of Saskatchewan, and W. T. Thompson, M.E.I.C., district engineer, province of Saskatchewan.

### Improvement of the Professional Status

The last day was taken up with a discussion on the general welfare of the Institute, a regular meeting of the council of the parent institute, at which councillors from the four Western provinces were present, and excursions during the afternoon to parts of interest, including the new reinforced concrete bridge, power house, filtration plant and country club.

Group of delegates attending Western Professional Meeting of the E. I. C. at Saskatoon.

The discussion on the welfare of the Institute was opened by W. M. Scott, M.E.I.C., commissioner of the Greater Winnipeg Water District, with a general address on the situation. He did not go into detail, but outlined the principal subjects of interest to Canadian engineers to-day, stating that the chief points for discussion were: (1) Legislation, (2) remuneration and classification, (3) publicity and the status of the engineer. He further said that the engineering profession is composed mainly of university trained men without whom the public would find it hard to exist, and therefore the engineers should take their part in the public life of the community.

Engineers should not consider themselves the only profession in the community, however, he said. It would be egotistical for any one profession to rate itself superior, for all are a necessary part of the community. He expressed the belief that the public appreciated the services of the engineers, but that the appreciation was rather a passive one than an active one, except in certain cases where the work and services of engineers was fully understood.

George W. Craig, M.E.I.C., city engineer, Calgary, assisted Mr. Scott in introducing the discussion to the meeting. Mr. Craig discussed the status of the engineering profession. Which profession takes the more prominent part in public life—the lead in public matters? he asked. The engineers don't get proper recognition, he declared. There are splendid opportunities in a country for the engineers to associate with the other professions and express their beliefs. How many engineers belong to the commercial and community clubs, such as Rotary, etc.? he asked. The engineers should fill their rightful places in these clubs and gatherings, he declared, and get up and state the "bald facts" whenever necessary. They should not be retiring and keep themselves secluded.

### The Engineer in Business

The education of an engineer admirably fits him for business, he stated, but instead the engineer is usually too engrossed in his engineering calculations to take any interest in the business end of a project, and prefers to leave it in the hands of promoters, generally men without any practical engineering experience or training. He believed that there was a big field for engineers in legitimate business promoting.

A more prominent part should be taken by engineers in municipal affairs. Now that the managerial system of municipal government is gradually being endorsed, the scope of municipal activities for the engineer is rapidly broadening, for his training admirably adapts him to take a prominent place in this form of government. Municipal government is as yet in a transitional state, but when managerial government is finally established, will the engineers be ready to take ther rightful part? he asked.

Major Walken, of Vancouver, who occupied the chair, stated at the conclusion of Mr. Craig's remarks that the legislation regarding engineers in British Columbia had not yet been in operation long enough for them to state definitely whether it was really benefiting the engineering profession in that province.

### Public Service for the Engineer

He expressed the belief that engineers were fitted and should offer themselves for public service. The country should not be run by politicians, but by the best men, and he thought that engineers, by reason of their training and experience, were fitted to take an active part in public life.

He then opened the meeting to general discussion on the matters introduced, and a lengthy discussion followed. It was apparent from the tone of all who spoke that none of them were satisfied that the engineering profession is strongly enough represented in the public life of the country. All were agreed that the training and experience an engineer receives fits him to take an executive position in the public works of the country.

None of them expressed any satisfaction regarding remuneration. They were in favor of a schedule being prepared, but not unless legislation is enacted to see that it is enforced. This brought up the classification of professional engineers, which seemed to be a hard matter to make any definite statement on. Professor E. G. Mathieson, of Vancouver, who took a prominent part in the discussion, pointed out that, although there was legislation in British Columbia, it did not prevent any person from hanging out a shingle as a professional engineer. Those who are not really qualified engineers, but tackle professional work and then make mistakes, cause the stigma to react on the whole profession, and he declared it was time the profession made a determined stand in the matter and obtained legislation whch made the classification more definite.

Fraser S. Keith, of Montreal, secretary of the Engineering Institute of Canada, state that the president, J. M. R. Fairbairn, was taking active steps in these matters.

### The Value of Publicity

M. T. Cantell, A.M.E.I.C., editor of The Western Canada Contractor and Western Canada Coal Review, Winnipeg, took part in the discussion. He declared that the status of the engineer depended to a very large extent on publicity, and that the engineer, being generally of a modest disposition in this respect, was very reluctant in taking advantage of the opportunities offered by the public press and various professional journals in getting matters before the public and authorities responsible for the development of engineering works. He further stated that The Western Canada Contractor, Contract Record, Western Canada Coal Review, and Electrical News, all of which have a large circulation throughout the West, were prepared to give considerable space to proceedings of the Institute, description of works carried out by members, or other matters of engineering interest. Mr. Cantell advised the members to take every advantage possible of such exceptional opportunities for publicity.

Practically every angle of these questions of such vital interest to the engineers was discussed, from the university standpoint, the civic standpoint, the professional and even the public standpoint, and it would seem as if the institute and the engineers, individually and collectively, are determined to settle these issues in the near future in a manner that will bring them more satisfaction than they have had heretofore.

The Western professional meeting for 1922 will be held in Vancouver, but the date is not yet fixed. The next annual meeting of the parent institute will be held in Winnipeg during February, 1922.

# Good Roads Cost Nothing

## Eventually a Policy of Improved Highways Pays for Itself—Money Spent on Road Construction Guarantees National Prosperity

By A. W. CAMPBELL, M.E.I.C., Dominion Highway Commissioner, Ottawa.

The truth of the title is substantial if emphasis is placed upon the word "good"; it is indubitable if there be added and stressed the word "eventually," premising always that they are built with a cost proportionate to transportation service only. It is then only another way of saying, "Good roads pay for themselves."

Money spent in building good roads is more than a certain necessary capital expenditure, more even than an investment; rather it is a premium guaranteeing a national annuity of prosperity. And so Canada's new roads are being built well, raised well up out of wet strata, wide, straight, permanent, in keeping with the greatness of our country. Such roads constitute public utilities that leaven the whole mass of business relations, and benefit every class.

Road-building is the greatest building activity going on in Canada to-day in point of financial value; yet, in the end, most of these roads will have cost the various provinces and municipalities nothing. The responsible officials have come to recognize that to allow bad roads, necessitating five horses for a one-horse load, to stay bad is evidence that progress and prosperity are not wanted, and that the communities unfortunate enough to be still surrounded by ruts are more or less inviting stagnation.

It follows that the policy of helping local municipalities to help themselves out of the mud and ruts, and of encouraging them to earn large bonuses for first, and even second-class, road construction has become very popular—a policy more than justified by results. It was a splendid combination of native Yankee shrewdness and of practicality which, realizing that roads cost nothing if they are or will be used enough to warrant making them good, inaugurated this policy in North America a quarter of a century ago.

The force of such an adage never dawned on the old nickle-wise-dollar-foolish back-numbers who used to flourish before the good roads era, especially where comparatively recent pioneering conditions both fostered and demanded a scrawny thrift. In Canada today it is generally recognized that true thrift consists in spending a dollar to save or earn two. Especially is the present a time of enlightenment regarding the value and benefits of improved roads. The whole tribe of good-enough-for-father-good-enough-for-me ideas of getting along with what improvidence has endowed a community, is becoming more and more distasteful to Canadians. The best, or at least a constant pursuit of the best, in methods and conditions of transport, at all events, is now a pretty general ambition. As a general thing, all classes immediately enthuse over the prospect of better roads. To the ubiquitous motorist and party, most probably none other than an erstwhile back-number, the best is none too good.

The question then naturally arises: Why the general satisfaction at the gradual passing of the old trails of corduroy, studded with thank-ye-marms, lined with boggy holes or groved by ruts? Why the extension daily in each of our provinces, weather permitting, of graded, aligned, smooth hard-surfaced roads? The answer is, of course: "Because experience shows that good roads cost nothing in the long run, as an initial heavy outlay in good stone properly consolidated and shingled, will return to the users in lower costs of travel, through lesser quantities of oil and gasoline burned, in reductions of repair bills through rack and strain, in time saving through travelling more miles per hour, and in immeasurably increased comfort and pleasure in travelling."

That is, having regard only to the place good roads have in the scale of wealth producing agents, and as factors in the national economy, always excepting needless losses through graft and wasteful incompetence, money spent in high-class highway construction is as the fabled bread cast upon the waters. Providing the first cost is equitably levied against the political units and persons benefitting, all are recouped in economic values alone. Hence a genuinely common sense now calls for stone of specified dimensons, of specified depths, and usually treated by painting on a mixture with specified materials, such as tar, oil or cement, each of specified and detailed qualities, and all put down with approved methods under experienced supervision.

Besides the inherent values in agencies lowering costs of transportation, there are other values quite as important, recognized and negotiable, in all transfers of property in localities served by real roads—roads that are built. These values cannot all be enumerated and they vary in number and amount in different localities. But to the extent that facilities are provided for wider and more pleasant social intercourse, healthful living, more recreation, and greater appreciation of the infinite variety and beauty of Nature's settings, capital invested in good roads pay big dividends on the common stock. The value of education varies with the individual, and the value of easy communications varies with the road.

Canada may become the Switzerland of North America when she has made the values of her countless natural beauty spots negotiable by building sufficient good roads. Eventually such roads will have cost her nothing. It will be statesmanship with plenty of precedents that will provide the necessary funds to build them. France has a department of roads and bridges that has served the nation greatly in both peace and war. A fraction only of the present bounteous tourist traffic harvest being reaped in France, Belgium and Italy would be possible had not the government of these countries placed huge sums at the disposition of the department of roads and bridges of each to restore and improve their systems of highways.

It will be an exceedingly interesting chapter of the great war that tells how building and maintaining regular, efficient road communications saved many a critical situation. Authorities agree that good roads did much to make victories possible at the first battle of the Marne and at Verdun. Had Poland and Galicia been interlaced with decent roads, numerous battles in which expected support and reinforcements arrived too late might have had different endings with a saving of thousands of lives and millions of roubles. The good roads of France cost her nothing; the bad roads of Russia eventually lead to political and economic bankruptcy.

In peace or war, **good** roads cost nothing **eventually**.

## THE ACTIVATED SLUDGE PROCESS OF SEWAGE PURIFICATION

By William Ransom, M. Inst. C.E., City Surveyor of Worcester.*

The purification by means of the activated sludge process has been well summarized by Professor Fowler when he states that it effects three operations, viz., a clarifying action rapid carbon oxidation, and nitrification, which are carried on simultaneously without any line of demarcation.

Broadly speaking all activated sludge plants are designed upon the following lines: (1) Preliminary treatment by removal of detritus and screening. (2) Aërating tank treatment, in which compressed air agitates the sewage, distributes the activated sludge, and supplies oxygen to the aërobic bacteria. Activated sludge must be present in a certain proportion in order to inoculate the raw sewage and to quickly effect the requisite purification. (3) Settlement tank treatment for the removal of the suspended sludge, and the drawing off of the effluent which is sufficiently purified to be discharged direct into a river or stream. Part of the settled sludge has to be returned to the aërating tank for activating purposes, while the rest can be used for manurial or fertilizing purposes. (4) Disposal of the surplus sludge.

### Methods of Application

In the early stages of bacterial purification the fill-and-draw method was adopted, but it was superseded by the continuous method. A similar evolution has taken place in the activated sludge process, and the fill-and-draw method has been replaced by the continuous method.

Mechanical means for agitating the mixture of activated sludge and sewage in the presence of air will yield the same results as agitation by means of compressed air. Mr. J. Haworth at Sheffield has produced by mechanical agitation very satisfactory effluents, and experiments are now being carried on in Glasgow and different parts of the country, but it is doubtful whether the cost of mechanical agitation will be able to compete with the compressed air method.

Mr. Haworth has secured agitation by means of mechanically driven rotary paddles, and aëration is effected by means of contact between the surface of the sewage and the atmosphere. This requires the use of shallow tanks, and the atmospheric surface has to be regulated in proportion to the strength of the sewage. At Glasgow it has been found that the period of aëration requires to be doubled when mechanical agitation is employed.

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*From a paper presented at the annual meeting of the Institution of Municipal and County Engineers.

It will probably be found that research work in the future will discard mechanical agitation and tend in the direction of securing the most economical depth of tank with the minimum of compressed air to secure circulation and aëration.

Some recent experiments have been carried out at Pasadena in California. Aëration and agitation were effected by pumping the sewage and air into the bottom of an activating tank through perforated revolving arms. It was found necessary to supply compressed air to secure proper purification, and the process proved more costly than the usual method of activation. Another experimental method has been tried at Hermosa Beach, California, where a diffusion wheel or impeller type of pump was used at the foot of the intake pipe for drawing in the air and sewage. Here again activation was imperfect, and mechanical agitation found to be no satisfactory substitution for the ordinary method by means of compressed air through diffusers.

### Advantages of Process

The activated sludge process may be depended upon to remove about 90 per cent. of bacteria and about 95 per cent. of the suspended matter from the sewage.

The advantages of the process are manifest from the inspection of any installation. There is freedom from the smell nuisance, and also from the plague of flies so often associated with sewage disposal. The area of land required for the treatment is extremely small, and the resulting sludge is one of the most valuable yet produced by any sewage process. Cold weather has very little effect upon the process. In America it has been found that it is sometimes necessary in severe weather to increase the supply of air.

Finality has, of course, not yet been attained in the process. There is room for experimental work in many directions, such as air distribution, circulation, size and shape of tanks, arrangements for reducing velocity and hastening sedimentation, and last, but not least, the profitable disposal of the sludge. Each new installation will produce its quota towards the solution of these problems, and sewage engineers will contribute to the general knowledge and advancement of the process as they record the successes and failures of their experimental work.

## The Intensive Road Building Programs of the Present Day Have Been Made Possible Only by Motor Trucks

The bottom views illustrate some operations in connection with the construction of Ontario highways. From left to right the pictures show: Kilmer and Barber's 5-ton truck loading hot asphalt on the Dundas mountain provincial highway; spreading hot asphalt on the same road; gravel being dumped on one of the Brant county roads.

**The illustrations at the side show tar spreading devices attached to motor trucks.**

The trucks shown are all LEYLAND machines.

# Standard Specifications for Road Construction Are Unworkable

## The Author Believes that the Varying Conditions Under Which Highways Are Projected Make Too Much Standardization Undesirable—A Definite Policy Must be Pre-determined

By M. A. Lyons, A.M.E.I.C., Chief Engineer Good Roads Board, Manitoba.*

Three years ago at the Western professional meeting of the Engineering Institute of Canada at Saskatoon, following papers on road construction in the three Western provinces, the apparent difference of practice in the construction of earth and gravel roads was noted by some of the engineers present, and a committee of three, one engineer from each of the three prairie provinces, was appointed to draft up "standard specifications including a road policy." I do not think that the movers of the resolution realized just what result was to be obtained from this resolution and I am sure it has never been clear to me just what was desired.

### Standardization in Specifications Not Desired

Examining this resolution, it appears to me that it might have been worded to read "a road policy including standard specifications for roads." I do not believe that road specifications should be made too standard or even any specification so standard that it cannot be adapted to the economic situation. While there are certain fundamental principles underlying road construction, it is my opinion that every piece of road must be considered by itself. The depth of the drainage ditches, the amount of earth in the road, the width of the road, the crown of the road, the location of the drainage ditches, the shape of the ditches, must be varied to suit the soil, the method of doing the work and the economic needs of the community. In a rolling country of light soil, and well settled, the type of road must be essentially different from the type required in a low, level country, where the top soil is of poor road material, where the sub-soil is heavy gumbo and where the traffic is comparatively light. I feel confident that a road specification suitable for the comparatively arid rolling foot hills of Alberta would not do for some of the wet, low lying country bordering on Lake Winnipeg. A roadway 24 feet wide might be justified in a section of the country where there was a heavy traffic, while it might be economically unsound to construct more than a 16-foot roadway or even less in a sparsely settled district. I therefore submit that either specifications for standard roads or standard specifications for roads are not really feasible. In fact, I am wondering if there is not sometimes an inclination to follow standard specifications too closely, and I feel that the engineer does not make as full use of his own technical training, judgment and experience as he should and that consequently designs are not as economical as they might be for the condition for which the design is made. It appears to me that the value of these professional meetings lies in hearing the other man's problems and how he solves them rather than in trying to have one engineer do things the same as another engineer under entirely different conditions.

### A Policy is the First Consideration

I have suggested that the matter of road specifications is a portion of the wider question of a road policy. This, I believe, is the vital question for those interested in roads. The construction of roads cannot be placed on a proper basis until the sound, fundamental principles underlying a road policy have been established and adopted, and I know of no man who is, or should be, better equipped to assist in the discovery of these principles than the engineer, and once having these principles established, I know of no better men to compel them to be put into effect than the engineers, if they will only so thoroughly believe in these principles that they will endeavor to show others why these are sound principles and will unselfishly stand on these principles, believing them to be for the public welfare.

In any undertaking to be successful it is absolutely essential to have a general plan to work to, and in order to prepare a plan the object of the undertaking must be understood. Like all transportation systems, there are two objects to be attained—one economic and one social. The social value of the system cannot be measured by human standards, but are none the less valuable for this. The economic value of a transportation system can be studied and measured, and in order to get the greatest value for money spent on a transportation system we find that we are immediately confronted, not with a town planning system, but a provincial planning system. We find that our roads are a vital part of our whole economic system. The first question therefore arises: Is the development of our province proceeding along the most economical line? Is it more economical to induce settlers to open up new territory and construct a poor system of roads to it while the older settled portions of the province are not fully developed, or is it more economical to fully develop the older portions of the province and supply a thickly settled, well developed country with a first-class transportation system and then to develop gradually to outlying districts along a provincial-wide plan as this becomes justified?

We see that the principles underlying the development of a transportation system are intertwined with a provincial-wide investigation of the suitability of lands in the older districts for further development, and the study as to whether or not it is better to develop these before opening up new lands.

### When Will Good Roads Pay?

Only about one-third of the organized portion of Manitoba is under cultivation or referring to the older and more thickly settled portions, slightly over one-half is under cultivation. The first question: Is the remaining portion suitable for cultivation? A careful survey would answer this question. Is it more economical to develop the arable portions of the high-priced lands and provide good transportation systems. Or develop the low-priced new land and supply this territory with a poor system and a fair one of the settled portions. Here is a field for investigation, but in order to show that it is not all in favor of developing the new section I wish to point out the following. Take a certain municipality in a new section of the northeast of Manitoba. It has an area of 530,000 acres, of which 2,300 are reported as under cultivation, and has about 1,600 resident farmers, an average of less than 1.5 acres per farmer. Think of the miles of roads which must be constructed for the produce of 1.5 acres of land. In order to serve this large number of people in such a poorly cultivated district the roads must be far from good. Think of the cost of hauling the surplus to market over this road, if there was any surplus! This farmer would be in the same position as the man who recently sent a carload of sheep to Winnipeg to be sold. After making the sale the broker wired that the farmer must send him $1.35 additional to make up losses on the sale. The farmer wired back that he did not have the money, but would send the broker another carload of sheep. The man with the 1.5 acres would owe himself money before he got half way to town.

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*Read in leading the discussion on the development of trunk highways at the Western Professional Meeting of the Engineering Institute of Canada, Saskatoon, August 10 to 12.

Consider another certain municipality in a well settled district with an area of 275,000 acres, of which 166,000 acres are under cultivation, and which has 483 resident farmers. The average number of acres under cultivation per farmer is about 340. Here is a place where the construction of good roads would pay. Would it not be better to have the 1,600 farmers who now have 1.5 acres under cultivation settled in a country where 60 per cent. is under cultivation and construct for this fully developed municipality a first-class system of transportation?

These examples show that the first step in our road policy is **provincial planning**.

### The Desirability of a Road Policy

It does not appear to me that the adoption of a road policy by this meeting would really get us any great distance towards our goal. We either do, or do not believe that a general road policy for the prairie provinces is desirable. If we do not believe that it is desirable why go to the trouble of establishing a certain road policy as the policy of the Western branches of the Engineering Institute? If we really do believe that such a policy is desirable let us take off our coats and get to work and find out what is the proper policy, for if we thoroughly believe that the policy is necessary and make no attempt to get it it seems to me that we are hardly sincere and that we fall short of doing our full duty. You will say that a committee was appointed to draft this policy, but there is a little more to it than writing out a nicely reading road policy. After the policy is drafted, it is of no use unless it is put into effect and the money found for carrying it out. This means that governments must be favorably inclined to the policy; taxpayers must see the soundness of it; agriculturists, merchants, manufacturers and auto drivers are interested in it and must be consulted; financial men must know that the policy is sound. Until these classes of men are satisfied, the mere drafting of a road policy and its adoption by this meeting would not actually achieve what we say we desire, although its adoption by this meeting might mark it as very worthy of careful consideration.

Personally I think that a sound, comprehensive road policy is absolutely essential to ensure the wise spending of the large sums of money which will go into road construction in Western Canada. Someone must and will take the lead in ascertaining what this policy should be and why should not this Institute take the initiative? It has been suggested that one way of doing this would be an offer of assistance to the governments by the Institute, towards studying and drawing up a road policy. Personally I had in mind the feasibility of going a little further and have the Institute, or a committee appointed by the Institute, endeavor to call a meeting of representatives from the three governments, from the unions of municipalities, from agricultural societies, and from the motor leagues, to make a study of a road policy. Now all this means a lot of hard, ceaseless and discouraging work, and, after a proper policy is arrived at, a lot of further work of education, publicity and persuasion before the policy can be put into effect. The policy will cover the expenditure of millions of dollars which must come out of the pockets of the taxpayers; and before the taxpayer can be separated from his dollar he will have to be shown where he is going to get one dollar and eight cents back in some form or other. But if this meeting is absolutely sincere in its belief that the adoption of a road policy in the three Western provinces is desirable, now is the time to start unbuttoning our coats for some hard work. Having been in touch with road construction for the past eight years, I might point out to those whose thoughts have been along different lines of work, some of the points to be considered in a road policy.

### Points to be Considered

Probably first comes the general policy of how the work is to be handled, whether by the provincial government, the municipal governments or both. If by the provincial government, is it to be by a commission or by a minister of highways, or as a sub-department of another department? Here is where you will strike snag No. 1, or perhaps it had better be called a sunken rock.

### Classification

Next, undoubtedly, is the classification of roads. This is essential in order to ascertain the class of construction, the cost of construction and a fair division of costs. There are the two purposes of roads: First, to bring the wealth of the farm to the main arteries of the transportation system, the railways; second, as passenger routes or through roads or provincial highways. These last are sometimes of little value locally, and in order to serve through traffic in many cases must be of a much higher type of road than will be warranted by the local traffic; and, on the other hand, many roads which serve as highways will be af greater benefit locally as market roads than as through roads. Market roads will be divided in two or perhaps three classes. Then there are the town-to-town roads which mostly serve some local purposes. As a rule, however, these are also main market roads.

It therefore appears that there might be four classes of roads in Western Canada. Now the problem is to classify these roads; and to say who is to do the classifying. Shall the roads be classified and their classification fixed by legislation so that there cannot be further dispute or shall the system remain flexible with its endless disputes entailed? Shall the classification be done arbitrarily by a body appointed to go carefully into the matter, or shall it be done by the local authorities and their decisions followed, or shall it be done by a dozen other methods which might be suggested. I want to tell you that there are whole bunches of worry and chances for disagreements wrapped up in these questions.

After the roads are classified how is the cost to be apportioned? Who by, and on what basis? Who should pay for provincial highways? Should the motorist pay the greater proportion? Undoubtedly any construction of a good Western-wide system of highways is worth more to the motorist who uses them than any license which he has to pay now. Some provincial highways are of very little local value; others are of more value locally than they are to the motorist. Who is going to pay for the market roads? Are they of such indirect general value to the province as a whole that the city taxpayer should pay his share or is the farmer the man who will get the greater part of the value for every dollar spent? Who is going to say how these costs will be apportioned? How about financing? Who will do it, and how shall it be done? Shall the provincial government do it all and collect from the municipalities? I can give you instances which would lead you to consider this method. Shall the municipalities do their share and the government its share? There are good reasons for doing it this way. Shall any department of the government have any control over the municipality in the spending of its share? Should the Dominion government bear a share of the cost, and, if so, which roads and under what condition and to what extent? How shall the work be paid for? Entirely out of capital expenditure, partly out of capital expenditure, out of current funds, entirely by debentures or partly by debentures, and for what term of years should the debentures be issued?

### Cannot be Settled by Engineers Alone

Then, about construction. Who will have charge of this, the municipality, the government or dual responsibility? Should the government do any construction or establish industries to assist in constructing roads? These are some of the points which must be settled before an acceptable policy can be drafted and ones which, in my opinion, cannot be settled by engineers alone.

I therefore submit as my own opinion that when we were asked to draw up a "standard road specification" you asked for something which is not desirable, and when you added "including a road policy" you handed to the three men something which they, as engineers alone, cannot satisfactorily handle. I do believe, however, that this Institute can be the nucleus of an effort to discover and establish a proper road policy for Western Canada, if we will but put the same force into our efforts that we are accustomed to put in tasks which we allow others to set for us, but we must seek the co-operation of other bodies of men in order to make a success of a road policy.

These views are put forward not with the idea of discouraging the drafting of a road policy, but to point out the desirability of securing the co-operation of other interested bodies in ascertaining what is a desirable road policy and then how it can be put into effect.

There are these two things about a road policy: First, the drawing up of the policy, and, second, getting it adopted, and I reiterate that it is almost useless to draw up a policy if we do not intend to secure its adoption. In drawing up the policy we must have the views of other people interested, as well as the views of the engineers, and in getting it put in force it certainly must have the public opinion back of it as well as that of the several governments, and I again point out that the establishing of a road policy is a part of the wider problem of provincial planning.

# Oils for the Preservation of Gravel and Macadam Roads

The enormous mileage of gravel and macadam roads and streets require some attention in order to make their use by traffic, comfortable to persons or to protect them from rapid deterioration caused by the wear of traffic until an opportunity presents itself to make substantial betterments. For these purposes asphaltic oils, called road oils, are much used for the surface treatment. Such oils are usually an intermediate product in the reduction of crude petroleum to asphalt, although the crude highly asphaltic petroleums are also sometimes used for this purpose.

There are two general classes of road oil, the one sufficiently fluid for cold application and the other so viscous that it must be heated before application. The former ordinarily contains a lower percentage of asphalt than the latter and the beneficial results from its use are not of such low duration. It has the advantage, however, of being more conveniently and less expensively handled. Successful treatment with either class requires that the road surface shall be in good state of repair, well consolidated, free from holes or depressions and thoroughly swept for the removal of dust and detritus before the application is made. Newly constructed roads should be permitted to consolidate under traffic before the oil is applied. Applications can best be made by means of a pressure distributor. Uniformity in rate of applications is essential to good results.

The cold oil should be applied at the rate of from one-third to one-half gallon per square yard depending upon the absorptive capacity of the road surface. This application should be covered with a uniform layer of dustless broken stone, all of which will pass a one-half or three-quarter inch laboratory screen, or with pea gravel in an amount just sufficient to absorb the oil and prevent the surface from picking up under traffic. As the oil becomes more viscous on exposure, a thin asphalt mat or carpet is produced which under favorable conditions should last throughout, at least one season. Subsequent treatments with from one-tenth to one-fifth gallons per square yard before the old mat has worn out, should produce equally serviceable results.

The hot oil is usually brought to a temperature of 200 de. F., before applying, the rate of application being about the same as for the cold oil. A somewhat thicker and more durable mat is produced owing to the higher percentage of asphalt which the oil contains, and except under severe conditions a single treatment should prove effective for two or more years, providing that breaks in the mat are patched as they occur.

In addition to the two classes of asphalt oils which have been described there is a third class known as dust laying oils. Such oils should not be used for the purpose of building a mat over the road surface. They should be applied only in sufficient quantity to lay the dust on the road and not be covered with stone chips or pea gravel. From one-eighth to one-fourth gallon per square yard is usually sufficient for this purpose. Successive light applications may be made as the road begins to show signs of becoming dusty. Thus during a season a single treatment may prove sufficient, but three or four may be required according to local conditions.

# Concrete Chuting Equipment

## Practical Information on the Erection, Operation and Maintenance of Plants for Pouring Concrete by Towers and Chutes—Typical Cost Figures

(From Engineering News Record)

There are two types of concrete chuting outfits in use, (1) boom plants under which may be classified unit plants and (2) continuous line plants. The continuous line plant has cable-supported chutes. It is the original form, but has been perfected by including improvements developed in the boom plant.

The boom plant is used almost entirely for building work, and, it is worth noting, is probably the largest machine built commercially for handling concrete. The unit plant differs from the boom plant in that it has no separate boom. The first section of the chute is trussed and a head line is used. This type of plant is of a simpler design and, as a general rule, is less expensive than the boom plant, although it requires about 10 ft. more head room to maintain the proper angle for the head line.

For continuous line plants, which are best suited to bridge and dam construction and other types of extensive operations, the arrangements are more varied. Here counter-weight chutes, developed primarily for boom plants, are added to give the chutes range beyond the line of the supporting cable.

### Plant Construction

Both steel and wood towers are used for chute plants. Although sectional steel towers are the most economical in the long run, there are still more wood towers used than steel. The life of a wood tower is limited to two or three jobs; the steel tower, with ordinary care, should be good for an indefinite number of jobs. The first cost of a steel tower is greater than that of the wood, but the steel tower effects a saving in erection and dismantling cost which pays for it on three or four jobs. Wood towers may be bolted or spiked; the salvage is greater with the bolted. A good average figure for replacement on a wood tower is 35 per cent. for erection. Steel towers are built in sections of 15 or 20 ft. Each tower has a standard bottom section which contains the tilting chute and swivel sheave and a top section which contains the necessary top sheaves. It may be increased or decreased in size by adding or subtracting standard intermediate sections. All steel towers are fabricated to template so that the various parts are interchangeable.

Whether using wood or steel towers, the rule for determining the maximum height of the tower required is as follows: "Take the maximum height at which concrete is to be poured above the tower base and add to this one-third of the distance through which the concrete is to be chuted, which takes care of the necessary fall in the chute line. To this sum add 20 to 30 ft. for necessary tower head room."

There are two general types of chute sections, the half-round and the egg-shaped. Each has its particular advantages and each fills all general specifications. Any chute 12 in. or 14 in. wide and at least 8 in. deep will handle all the concrete that it is practicable to hoist into it, under average conditions, if placed on a slope of one vertical to three horizontal, the recommended slope for chutes.

Chutes are now used in the construction of dams and other massive structures where plum stones were formerly used, it having been found that a 1:3:6:3 mix can be thus employed and handled at a considerable saving in cement. By this mix is meant one part of cement, three parts of sand and six parts of stone passing through a 2 in. screen and three parts of stone passing through a 4 in. screen.

The standard chute made by various manufacturers in this country is, at the present time, 12 or 14 gage metal. The heavier chute means longer life and the length of life of a chute depends entirely upon the type of aggregate used in the concrete. Gravel is comparatively easy on chutes, but trap rock or very sharp, hard sand shortens the life of the chute considerably. The method used for prolonging the life of a chute is relining. These reliners can be placed in the chute at the factory or later on at the job. They consist of a sheet of metal shaped to conform with the chute and of the same thickness as the chute. This reliner covers that part of the chute which comes in contact with the concrete.

It is very hard to state definitely the length of life of a chute in cubic yards of concrete, as it depends upon so many different factors. As a general average, the 14-gage chute has a carrying capacity of between 8,000 and 10,000 cu. yd.

Chute connections are a very important feature of chuting equipment. They are of two kinds: one for continuous line chute where no change in direction is required nor swiveling action necessary, and one for boom, unit and continuous line plants where swiveling is a necessary requirement. The purpose of the first type of connection is to provide flexibility in the chute line. It should be easy of attachment and not change or interrupt the flow of concrete. The purpose of the second type is to provide means for swiveling so that the concrete can be poured over a considerable area from the end of the chute. This chute connection should be designed to reduce splashing to a minimum, provide a stable support to prevent the chute from tipping, and to give, as near as possible, no interference to the flow of concrete. In selecting any chute section it is advisable to see that the chute is so designed that either type of connection can be removed at will, as the chute on one job may require a continuous line joint, and on another job, the other type.

There are certain relations between the size of mixer, size of elevator bucket, and size of tower hopper which should govern the selection of a plant. The table below gives a suggestion as to this relationship.

| | | | |
|---|---|---|---|
| Size of mixer ........... | 14-S | 21-S | 28-S |
| Size of bucket .......... | 14 cu. ft. | 22 cu. ft. | 28 cu. ft. |
| Size of hopper .......... | 20 cu. ft. | 30 cu. ft. | 40 cu. ft. |

In general, the rule may be stated in this fashion. "The working capacity of the elevator bucket should correspond with the wet batch capacity of the mixer. The tower hopper should be at least 50 per cent. greater in working capacity than the elevator bucket to allow for unforeseen holdups in pouring, and additional storage capacity."

### Plant Location

While the conditions are so divergent that it is impossible to lay down specific rules on plant installation, there are certain general rules which should be followed in so far as possible:

1. Since the cost of handling materials behind the mixes is of equal importance to the cost of handling the mixed concrete, the receiving and handling of cement and aggregates should be convenient to the mixing and hoisting plant.

2. It is desirable to locate the hoist tower in a central position so that the semi-circular radius of action of the boom can be utilized to full advantage.

3. The maximum efficiency of operation of boom plant equipment is confined to placing concrete within 130 to 160 ft. of the tower base. Where the reach is in excess of this distance, study is required to determine whether it would be more advantageous to chute the concrete into floor hoppers located at central points and within 130 ft. from the base of the tower and to handle it from these hoppers to the far portions of the work in buggies, or to attempt to cover the far portions of the work directly from chutes, using the more or less troublesome floor supports that would be required.

4. To warrant the installation of a steel-tower, quick-lift, counter-shift, counterweight-chute plant, the work should contain at least 4,000, or better 5,000 cu. yd. of concrete.

5. Where a building is so large that it is not possible to cover the entire work from one tower, the yardage of concrete will determine whether a two-tower plant should be installed or whether a one-tower plant should be used and buggies be employed as an auxiliary means of distribution.

6. The height of work does not offer serious difficulty, as steel towers are now being constructed to heights as great as 240 or 280 ft., this height covering the exceptional job. The ordinary building can be covered by a tower 200 ft. or less in height.

There are, of course, occasional construction operations involving the placing of large yardages of concrete which cannot be covered by general rules. In such cases it is wisdom to call into consultation experts who have had a wide experience in the handling of special work.

### Plant Erection

Towers, whether of wood or steel, should be guyed at 40-ft. intervals, these guys to run off to suitable anchorages at a slope of not less than 45 deg. with the vertical. Turnbuckles, with shackles, should be inserted at both tower and anchorage ends of the guy lines; the turnbuckles make it possible to take up slack in the guys for the purpose of plumbing the tower, and the shackles make it easy to "slip" a guy line either for the purpose of allowing a boom to swing, or for clearing some obstruction.

A crew of seven men and a foreman should erect 80 ft. of tower per day and set the guys. The dismantling of the equipment can be accomplished in approximately one-half the time required for erection.

It is always advisable to have the hoisting engine on the job before the erection of the tower is commenced, so that it will not be necessary to lift the tower parts by hand. First the bottom frame of the tower is set in place and the four lower corner posts are bolted into position and held together by the required struts and diagonals. All that is necessary for handling subsequent members, as the work gets away from the ground, is a light wooden gin pole about 16 ft. long, having a heavy spike in its lower end. The spike fitting in between tower members, will provide a good swiveling support for the pole, which is set within the tower and leaned over so that the upper end is outside and in a suitable position for hoisting the tower members.

All bolting of gussets and small members should be done on the ground so that mid-air work may be held down. Experienced iron workers will have no trouble in getting the various parts together, since similar parts are interchangeable. The heaviest members are the corner posts, which are 20 ft. long.

The one caution in connection with the erection of a steel tower refers to the tightening of the bolts. While all bolts should be put in place as the tower progresses in height they should not be tightened, this tightening should be postponed until the tower has been carried to its full height and plumbed, after which the erectors will go over it, making sure that all bolts are properly tightened. After the tower is in place the sliding frame fixtures are put on the tower at ground level and the tower hopper is bolted into place at a convenient elevation. The boom is then erected on the ground and the sliding frame is raised sufficiently to allow the boom hinge connection to be put in at ground level. The boom is then rigged at the proper inclination and the entire plant lifted to an elevation convenient for attaching the counterweight chute, this counterweight section likewise having been completely assembled on the ground. By this method there is practically no mid-air work after the tower has been erected.

In building a wood tower, carefully constructed templates should be made exactly in accordance with the tower drawings. These templates should contain the exact location of all bolt holes. If possible each timber should be marked with a number. In other words, the corner posts should all bear one number, the cross braces another, sway braces another, and so on. By so numbering, the workmen who are erecting the tower can signal for a certain piece of timber and be assured that when it is sent up it is the proper piece. One of the most important things in erecting a wood tower is the guying, and at the time of starting to erect the tower, the first thing that should be done is to locate the guy anchors or deadman in order that there may be no excuse for continuing the building of the tower without guys because no anchorages have been provided. When the tower has reached the height of between 35 and 40 ft. the first set of guys should be attached. If the contractor plans to use his wood tower on two or three jobs it should be of bolted construction.

Continuous line chutes are made in lengths of 10, 20 and 30 ft. A continuous line chute connection should be placed at least every 30 ft. in the line, and the chute line should be supported by manila rope from the main cable at least every 30 ft. and preferably every 20 ft. The overhead cable should be of plow-steel. The supporting ropes should be ¾-in. manila. A double 6-in. wood block and a 6-in. single wood block should be used with the manila rope for supporting the chutes. The chutes are equipped with hangers for attaching the supporting ropes.

Two methods are in common use for connecting the manila ropes to the overhead cable. The overhead cable may be firmly lashed to the top of the hoist tower at the point where it crosses the tower and the back kick of the line can be taken care of independently, or the overhead cable can be run on a set of rollers over the top of the tower into a dead man. Both methods are used in actual practice and both methods are satisfactory. The sag in the supporting cable should be from 8 to 12 per cent. The approved method of placing long lines of cable-suspended chutes, is first to put up the chute suspension cable and then to put the chutes in place at ground level, one by one, pulling the entire line up toward the tower as the line of chutes is lengthened. Standard trolleys which ride on the suspension cable can be obtained for this purpose. These trolleys are held in their proper position on the cables by a spacing line. Running the chutes up on the suspension cable rather than lifting them vertically into place, as is sometimes done, saves a considerable amount of labor.

### Plant Maintenance

Depreciation of modern steel-tower gravity-plant equipment is confined almost entirely to the chutes, there being otherwise only the rollers on the hoist bucket to wear and practically nothing on the tower, tower hopper or boom. The amount of concrete which a chute will convey before becoming worn out depends upon the aggregate. A trap-rock aggregate is more severe in its action than a gravel aggregate. As a general average, the carrying capacity of an ordinary 14-gage chute runs between 8,000 and 10,000 cu. yd. Where it is known that a given set of chutes will have to handle more than this amount of concrete on one installation, the best practice is to have interliners of like weight put in the chutes at the time of their manufacture. These liners extend up on the sides of the chutes only as far as the concrete normally piles in transit. At a time when the original unlined chute would be worn out only the liner plates on the lined chutes will have become worn through. It is relatively simple and inexpensive to replace these plates, thus making the chute sections practically as good as new.

To hold down the depreciation of chutes, they should be handled with reasonable care so that they are not dented (a high spot in a chute very soon results in a hole) and they should be kept clean. The approved method of keeping the chute lines clean is either to run a water line to the tower hopper or to elevate water in the hoist bucket, and flush the chute line whenever operations are to cease for a period in excess of half an hour. The addition of liners, of course, makes the chutes stiffer and reduces the chances that they may become dented. Chutes, as they leave the manufacturer, are ordinarily painted on the outside and given a slush coat of heavy oil on the inside, it having been found disadvantageous to paint the inside because the paint, until worn off, seriously retards the flow of concrete. When equipment is to be laid up for the winter, good practice indicates that the painted parts be repainted if they have been weathered to any considerable extent, and that the inside of the chutes be covered with a slush coat of heavy oil.

### Plant Costs

Cost varies with the character and extent of the equipment. The cost of a specific installation and of a representative operation are, therefore, as truly indicative as are general figures, which have to be qualified in many ways. Any cost figures, it may be repeated, are merely indicative. Absolute costs cannot be given. These warnings must be kept in mind in studying the examples cited.

The cost of a 160-ft., 1-cu. yd. batch steel tower determined on a building operation in New York City in July, 1920, was:

| | | |
|---|---|---|
| Steel tower | | $2,325 |
| Blocks and cable | | 325 |
| Erection at $1.50 per ft. | $240 | |
| Dismantling at 50c per ft. | 80 | |
| Depreciation 5 per cent. on $2,650 | 133 | |
| Trucking | 50 | |
| Total fixed charges | | $ 503 |
| Total charges—first job | | 3,153 |

An estimate of the cost of a timber tower for the same operation is as follows:

| | | |
|---|---|---|
| Cable and blocks | | $325 |
| Lumber (50 bd. ft. per running ft. @ $80 per M). | $640 | |
| Framing at $1.50 per ft. | 240 | |
| Bolts and nails at $1.25 per ft. | 200 | |
| Tower before erection | | $1,080 |
| Tower erection—$1.50 per ft. | $240 | |
| Dismantling at $1 | 160 | |
| Depreciation at 50 per cent. of $1,405 | 703 | |
| Trucking | 50 | |
| Fixed charges | | $1,103 |
| Total charges—first job | | 2,558 |

As an example of operating costs the Gardner-Lucas Building, New York City, is selected. This building was constructed in 1920. It required about 8,000 cu. yd. of concrete and the organization was as follows:

| | |
|---|---|
| 1 foreman at $1 per hour, per day | $8.00 |
| 1 hoisting engineer at $1 per hour, per day | 8.00 |
| 1 mixer engineer at $1 per hour, per day | 8.00 |
| 1 laborer on sand at 60c per hour, per day | 4.80 |
| 1 laborer on gravel at 60c per hour, per day | 4.80 |
| 2 laborers on cement at 60c per hour, per day | 9.60 |
| 1 laborer on hopper at 60c per hour, per day | 4.80 |

| | |
|---|---|
| 1 mixer operator at 70c per hour, per day | 5.60 |
| 1 mixer helper at 60c per hour, per day | 4.80 |
| 2 laborers spreading, 60c per hour, per day | 9.60 |
| 2 chute handlers at 60c per hour, per day | 9.60 |
| | $77.60 |

The average day's run was about 300 cu. yd., making the cost of mixing and placing about 25c. per cubic yard. The average mixing and placing cost for the entire job was 36c per cubic yard.

A man with a buggy will average 12½ cu. yd. per hour, or 20 cu. yd. on an eight-hour day. It would require fifteen laborers to place 300 cu. yd., one laborer would be required on a floor hopper, and four to move runways. So on a similar job using the buggy method, the organization would be as follows:

| | |
|---|---|
| 1 foreman at $1.00 per hour, per day | $8.00 |
| 1 hoisting engineer at $1.00 per hour, per day | 8.00 |
| 1 mixer at $1.00 per hour, per day | 8.00 |
| 1 laborer on sand at 60c per hour, per day | 4.80 |
| 2 laborers on gravel at 60c per hour, per day | 9.60 |
| 1 laborer on cement at 60c per hour, per day | 4.80 |
| 1 laborer on tower hopper at 60c per hour, per day | 4.80 |
| 1 mixer operator at 70c per hour, per day | 5.60 |
| 1 mixer helper at 60c per hour, per day | 4.80 |
| 15 laborers—buggies at 60c per hour, per day | 72.00 |
| 1 laborer, floor hoppers, at 60c per hour, per day | 4.80 |
| 4 laborers, runways, at 60c per hour, per day | 19.20 |
| 2 laborers, spreaders, at 60c per hour, per day | 9.60 |
| | $164.00 |

With an average day's run of 300 cu. yd., the cost per yard for mixing and placing would be 53c by using the buggy method with necessary crew.

### Conclusion

Concrete gravity plants are machines for placing concrete at any point in a considerable horizontal area, at any elevation. Mobility and permanent construction are necessary if the machine is to be employed on several operations, and this repeated use is essential to economy of plant investment. Proper installation, perfect maintenance and skillful operation are required for maximum production. These call for intelligent mechanical direction and experienced machine operators.

## MONTREAL CONTRACTOR DIES.

Mr. Michael Connolly, well known Montreal contractor died very suddenly at his home in that city recently. Deceased was 76 years of age.

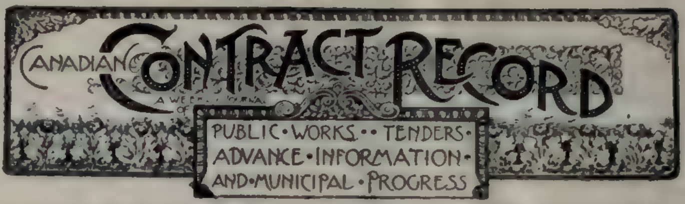
## THE WAGE OF IRON WORKERS REDUCED.

The wage scale of the Amalgamated Iron, Steel and Tin Workers, at Hamilton, has been fixed for the next 12 months. A general reduction of 4 per cent. on last year's scale is in effect.

### Trade Incorporations

Bancroft Marbles, Limited, with head office at Toronto, capital $1,600,000, to carry on the business of quarry masters and stone merchants.

Montreal Road Construction Co., Limited, with head office at Montreal, capital $20,000, to carry on the business of road contractors.



# 31 Years Ago

*Items from the issue of August 30th 1890*

(Note the old hand-worked wood cut engraving that was used in the earliest issues.—Editor.)

Windsor, Ont.—Mayor White is the authority for the statement that a waggon and passenger tunnel will be built under the Black River at Port Huron.

Lethbridge, N.W.T.—Application is being made for a charter for a company which is being formed to supply the town with water and electric light.

Montreal, P.Q.—The city clerk, on behalf of the waterworks department, is calling for tenders on 75 five-nozzle fire hydrants. Deliveries to be six per week from time contract is awarded.

Toronto, Ont.—Contract awarded for King Street Subway to Owen Sound Quarrying & Construction Co., 67½ cents per lineal foot for 6-in. straight and 90 cents for circular.

Hamilton, Ont.—The Water Committee recommend acceptance of the following tenders for supplies: James Robertson & Co., Toronto, for lead pipe at, per 100 lbs., $3.94; Alex. Gartshore, for cast iron main water pipes at, per net ton, $40.00.

Toronto, Ont.—It is reported that the preliminary plans have been prepared for a mammoth hotel on King Street. Geo. A. Cox, S. H. Janes and Robt. Jaffray are mentioned in connection with the project.

Building permit has been issued to the Trustees of the Church of the Redeemer to erect a rectory and school house at the corner of Bloor and Avenue Road. Cost to be $16,000.

Brantford, Ont.—Mihan, Elliott & Phin, of this city, have been awarded the contract for excavating the approaches to the St. Clair tunnel at Sarnia and Port Huron. Contract amounts to $200,000.

The City Engineer of Toronto has taken upon himself the responsibility of appointing a third plumbing inspector. . . .

Leading editorial: "Adhesive Strength of Sulphur, Lead and Portland Cement for Anchoring Bolts."

The Ontario Association of Architects further endorse their approval of the "Contract Record." (At their convention held in Toronto, November 20th, 1889, they signified their approval and pledged their members to use this journal as their medium of communication with contractors with respect to advertisements for tenders.)

Current prices: Brick, common, walling, $7.50; good facing, $9.00; pressed, f.o.b. Milton, $17.00; sand, per load of 1½ cubic yards, $1.25; cement, Portland, per bbl., $3.00; Thorold, per bbl., $1.50; nails, finishing, 1 inch, per keg, $5.75.

# Advantages of Complete Electric Installations in Houses

## An Address delivered to the Members of the Manitoba Electrical Association

By Fred. T. Shipman*

As we approach the subject of the contractor-dealers' part in a boost for the "Home Electrical," we realize it is not a new one, and to those who may have made a study and are conscientiously doing their part, my remarks may seem commonplace. We hope, however, that in reviewing the matter some worth-while feature may appeal sufficiently to engage your interest. At times these matters which are considered commonplace may, by the application of thought and action, be lifted out of the rut and made worth while.

Should the farmer in thickly populated countries like England fail to apply the best methods in cultivating the small piece of land at his disposal, thereby increasing production, his income would be so small he could not exist to-day.

As time progresses the same reasoning will apply to our industry. Therefore, it may be well to pause by the wayside, look over the situation and see if there is room for improvement.

### Home Electrical Equipment

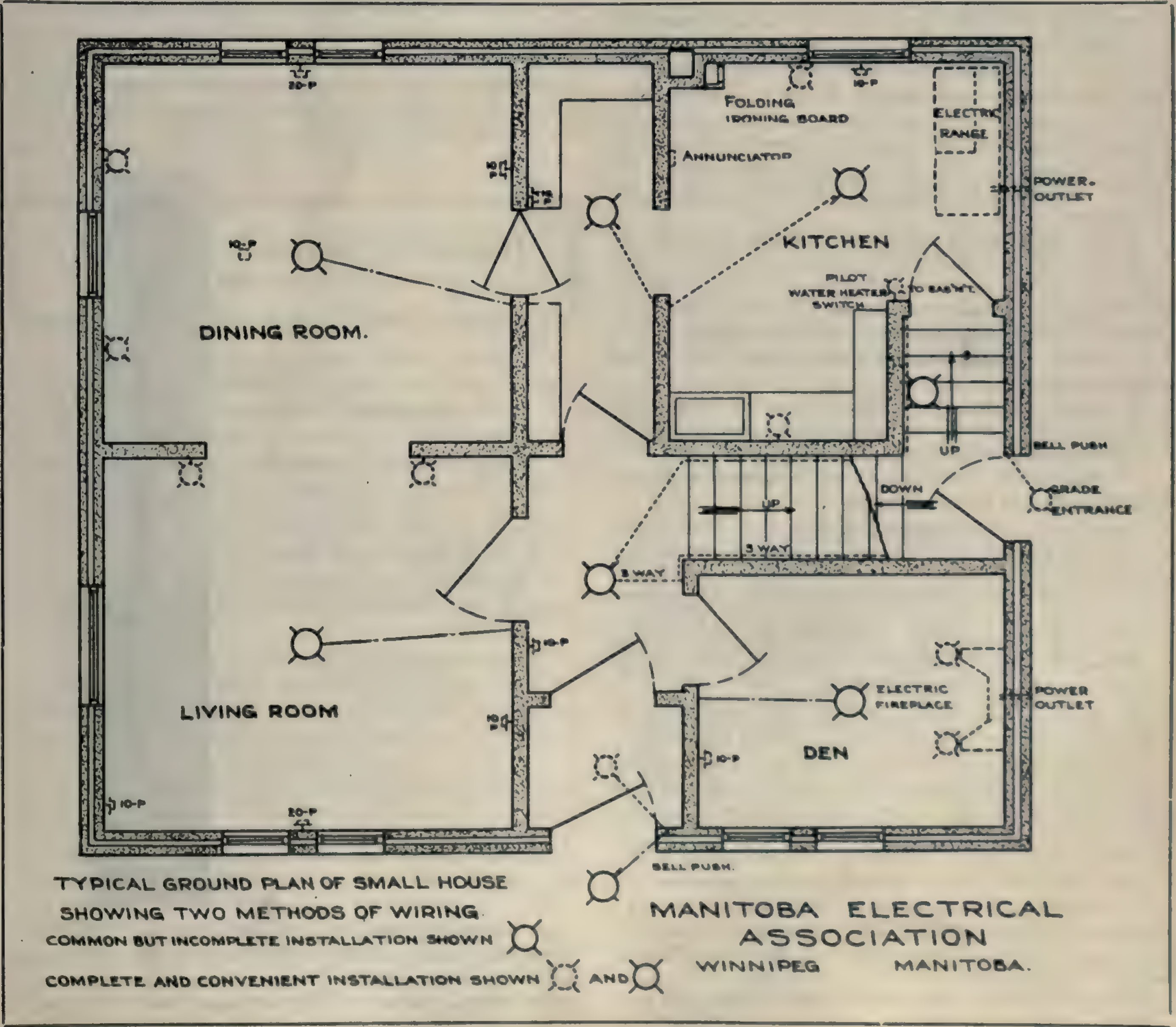
Most of us recognize the advantage of electrical equipment in the home, but frequently we overlook opportunities to increase our business and contribute as far as possible to building up the industry.

Occasionally our anxiety to get the order leads to "pruning" or an endeavor to see how much of a given installation can be omitted in order to "keep the price down" rather than trying to see how much can be added to a reasonable degree, thereby increasing our own business and helping the industry.

Frequently in our haste to get off one job and onto another we forget about the proverbial "bird in the hand is worth two in the bush." We should undoubtedly make the most of the job in hand before jumping to the one in view. Incessant jumping increases overhead and therefore eats into profits, when there are any.

Show me a better prospect than the customer who proudly boasts that his home is wired for a range, appliances or convenience outlets. Many of these appliances are necessities today.

The cheap rates available for current, for which we are duly thankful to our power companies, offer an invincible argu-



TYPICAL GROUND PLAN OF SMALL HOUSE SHOWING TWO METHODS OF WIRING
COMMON BUT INCOMPLETE INSTALLATION SHOWN
COMPLETE AND CONVENIENT INSTALLATION SHOWN AND

MANITOBA ELECTRICAL ASSOCIATION
WINNIPEG MANITOBA.

---

*Superintendent McDonald and Willson Lighting Co.

ment in favor of the complete wiring of every home.

The contractor who fails to remind the customer of these rates deserves only what he gets in business.

### Minor Building Costs

Electric wiring is one of the least of building costs and contractors should discourage every attempt by any one to cheapen, or eliminate, any part of an installation.

The customer who finds after a while that his house is half wired and things have to be torn to pieces, or at least so he imagines, is not so very enthusiastic about adopting the "cook by wire" method.

Every contractor owes it to himself, his customer and the industry to see that every installation is as complete and convenient as possible. This is not only a duty, but a profitable one.

Often a suggestion or recommendation from the contractor will accomplish much. Most people realize that the contractor is an authority and qualified to handle this detail of building.

We should never lose sight of the fact that each home is a prospect for equipment from $800 up, in addition to the wiring. The $800 represents a modest equipment and can be easily increased by three or four hundred dollars under present conditions. As the present rate of development it is not difficult to forecast that the above amount can be largely augmented.

### An Extensive Field

Remember, that while the simple outlet seems a small item and perhaps looks like two dollars' worth of business and probably twenty cents profit, some day a $75 vacuum cleaner or $200 washer will be bought and attached to the humble outlet. You, Mr. Contractor, by remembering the little outlet, will have a good argument with which to approach your prospect. If you don't sell him someone else will, and you in turn will no doubt reciprocate by connecting your goods to another fellow's outlets.

As time progresses the owner of the home begins to look for means to improve the place—why not assist him to attain convenience and to enhance the beauty of the home? Don't let the furniture man and the decorator do it all. Judicious expenditure on many useful appliances, beautiful lighting fixtures and convenient portable lamps is a field he should not be permitted to overlook.

We should endeavor to see that he does not have to tear the floors up and the walls down to provide outlets sufficient for connection of his many requirements.

A complete and convenient wiring installation is remembered long after the price is forgotten.

### How Shall We Do It?

We must help the customer to realize the advantage and value of complete and convenient installations. This can be accomplished in many ways, some of which are as follows:

Through giving the subject constant thought and attention.

Through the public press and our own advertising. In our window displays and store arrangement.

By advising the architects, builders and owners at every opportunity. By demonstration at our electrical exhibitions.

We have all probably observed the methods used in selling talking machines. They appear to be worthy of study and emulation and could probably be employed profitably in our own field. Note the intensive cultivation that has been going on for years in that business. Every home is considered a prospect, and apparently they will never pause until every home is a purchaser. It is interesting to note that now they are advocating a change of style which would open up the whole territory again. This is surely a shining and outstanding example of the selling art.

In our observation people hesitate more to spend $75 for a vacuum cleaner, a necessity, than they do to spend two or three hundred for a Victrola.

### Co-operation Urged

To endeavor to change this sentiment seems to be worthy of a trial. It would not be a small undertaking and would require the unremitting and united efforts of the most capable men in our industry.

Many of our manufacturers deserve credit for developing the washing machine business, vacuum cleaners and some other lines. We should help them in their efforts, as any movement to improve the industry is bound to help us.

"The servant is worthy of his hire." Let us in the electrical industry unite in rendering the best possible service to humanity. When we are satisfied that we are doing our work faithfully and efficiently we can surely hope and strive for more and fair remuneration.

To the contractor-dealer I should like to leave this final thought: Every outlet means future business. That we should all work for the future as well as the present and reap the harvest when "outlets are converted to incomes" may well be the goal of every electrical contractor-dealer.

## Ornamental Lighting along Sunnyside Boulevard, Toronto West

Considerable attention has been directed recently toward the Sunnyside section of the Humber Boulevard, work on which is sufficiently far advanced to give the general public a fair impression of the complete boulevard development as planned by the Toronto Harbor Commission.

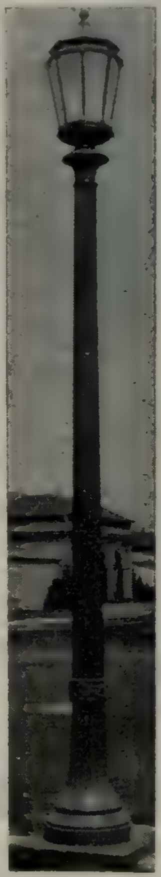


Fig. 1: Lighting Standards to be installed on the Humber Boulevard. They will be mounted 100 feet apart and carry 1000 c. p., 20 ampere, series lamps. Each standard will be equipped with its own transformer housed in the base.

Arrangements have been completed between the Harbor Commission and the Toronto Hydro-electric System for the boulevard lighting, and the Toronto Hydro engineers have recently placed orders for the lighting standards and other equipment.

Local conditions influenced the Harbor Commission to select a lantern type of lighting fixture, as shown in Fig. 1. This unit will be made of cast bronze with Colonial opalized stippled glass panels on the sides and top. The fixture will house an 8½-inch Holophane dome refractor with a porcelain enameled top reflector constituting the refractor holder. The combination of reflector and refractor is designed to direct the maximum light on to the street surface at an angle of approximately ten degrees below the horizontal, at the same time permitting enough light to escape upward to properly illuminate the glass panels in the top of the lantern. Pressed steel poles of very pleasing design, furnished by R. E. T. Pringle, Ltd., give a mounting height of approximately fifteen feet at the light centre. With this mounting and with the particular quality of stippled diffusing glassware used, there will be a complete absence of glare.

The units will be mounted at approximately one hundred-foot intervals, arranged opposite to each other. Initially 600 c.p. lamps will be used, but ultimately it is proposed to use a 1,000 c.p. lamp in each fixture. The lamps will be 20 ampere series, designed for tip-up burning. Each lamp will be supplied by a 1,000 c.p. 6.6/20 ampere I.L. series transformer, buried at the base of the pole. The series system will be fed by a number of automatic constant current transformers of the outdoor type. Provision is made for reducing the candle power of the lights after midnight in order to materially increase the lamp life.

All of the equipment except the standards and the underground cable will be supplied by the Canadian General Electric Company, the bronze lantern being manufactured locally at their Architectural Bronze and Iron Works.

# Mainly Constructional

**East and West—From Coast to Coast**

A notice appearel in the Ontario Gazette recently of the change of name of the Windsor Veterans Contracting Company, Limited, to Steward Construction Company, Limited.

The Ontario Provincial Conference of Bricklayers and Stonemasons will open in Kitchener, Ont., on September 6. Messrs. John Sutherland, E. Trenwith and William Jarvis will represent the Toronto union at the conference.

The town council of Aylmer, P.Q., has decided to apply to the provincial government for a $500,000 loan to finance the reconstruction of homes destroyed in the recent large fire. This loan will be applied for under the provincial housing regulations.

The thirty-seventh annual meeting of the Trades and Labor Congress of Canada opened at Winnipeg recently. Over five hundred representatives of organized labor from all over the Dominion were present at the opening and were welcomed by Hon. T. C. Norris, Premier of Manitoba.

Building figures at Brandon, Man., are far ahead of last year's. The total value of permits issued up till the middle of August was $714,260, or over $300,000 ahead of the total figure for last year. With four and a half months to go, it may be safely said this year's permits will double, at least, last year's figure.

Mr. W. H. Cooper, Hamilton contractor, was recently awarded the bulk contract for the new Lottridge Street School in that city. Mr. Cooper's figure, $223,449, was the lowest of the six bids. It is estimated the total outlay on the building will be from $300,000 to $325,000. This latter figure, however, is about $150,000 less than the estimated cost of carrying out this contract last year.

An agreement has been reached between the Manitoba and Ontario provincial governments for the connecting of the two provinces by a national highway. Construction of the Ontario end of the road from Kenora to the Manitoba boundary is now in progress, and is expected to be completed this year. The road will enter Manitoba at a point between West Hawk and Falcon Lakes in township 17, range 9.

Sir Adam Beck is endeavoring to secure the co-operation of the municipalities between London and Port Stanley, in the construction of an asphalt road between these two points to replace the present gravel road. The authorities at London have assured Sir Adam that the scheme meets with their approval. The project would receive, under the Provincial Highways Act, the financial assistance of the government. It is also proposed to equip the highway wth lights from end to end.

A brief summary of the work accomplished by the Winnipeg Housing Commission this year shows 194 loans passed, 177 houses commenced and 62 already occupied. Together with the 151 houses constructed by the commission last year, loans approximating $1,400,000 have been approved, of which sum $808,000 has actually been paid out, the difference in these two figures being accounted for by the money which will be paid out on buildings at present under construction. The commission must be congratulated on the excellent progress it is making in handling the housing problem.

## Personal

Mr. Norman G. McDonald succeeds Mr. Stanley Shupe, who resigned recently as town engineer of Oshawa, Ont.

Mr. R. S. C. Bothwell has been appointed superintendent of construction of the Canadian Johns-Manville Company at Toronto.

Messrs. Emile E. Delay and H. C. Flack, formerly members of the firm known as Architectural Studio of Regina, Sask., announce that this partnership has been dissolved.

Mr. Gaudiose Hebert, who resigned recently as president of the Catholic National Union of Quebec, has been appointed inspector of public buildings for the province. Mr. Hebert has been connected with the labor movement in Quebec province for over thirty years.

Messrs. Alex. Forbes of Fredericton, and C. Roy Forbes of Devon, N.B., have formed a partnership for the purpose of carrying on the business of general contractors and builders. The company, which will be known as A. & R. Forbes Company, will open offices at the town of Devon, N.B.

Mr. Wm. Lawrence McFaul recently resigned as city engineer of Sault Ste. Marie, Ont., to accept an appointment as assistant city engineer of Hamilton. Mr. McFaul is a graduate in civil engineering of the University of Toronto. Following his graduation he was appointed assistant city engineer of Port Arthur, Ont., which position he resigned in 1914 to accept an appointment in a similar capacity at Sault Ste. Marie. In 1915 he succeeded to the position of city engineer, which position he held until recently, with the exception of two years' service overseas.

## Obituary

Mr. A. H. Byers, superintendent of the Steel Company of Canada's forging plant at Gananoque, Ont., died recently at his home in that town.

# CONSTRUCTIONAL ACTIVITY

## Period of August 24 to August 30, 1921

*Dominion Wide Service Exclusive to "Contract Record & Engineering Review"*

### Waterworks, Sewerage and Roadways

**Alvinston, Ont.**

A. S. Code, Engr., Alvinston, will prepare plans for cement sidewalks for Trooke Twp. Council.

**Dundas, Ont.**

Town will construct extension to watermains at cost of $18,000. C. R. Murdock, Engr.

**Gesto, Ont.**

Construction of tile drains at cost of $50,000 is contemplated by Colchester North Twp. Council. A. C. Atkinson, secy.-treas.

**Hamilton, Ont.**

S. H. Kent, City Clerk, will receive tenders until Sept. 19th for construction of storm overflow sewer on Wellington St. from Hamilton Harbor to south of Ferrie St. Tenders will also be received for storm sewer on Wellington St. from south of Ferrie St. to Barton St. Plans with Engr., E. F. Gray. Marked cheque for 10 per cent. of tender required.

Construction of concrete curbs on various streets is planned by City.

Construction of asphalt pavement on York St. at estimated cost of $110,000 is contemplated by Council.

**Longueuil, Que.**

Paving work costing $227,000 is contemplated by Town. L. A. Ste. Marie, Engr.

Town Council plan opening of new street through Messier Estate.

**St. Lambert, Que.**

E. Drinkwater, Engr., has plans and will receive tenders until Sept. 6th for 2,044 lin. ft. of 36 in. internal diameter reinforced concrete pipe, 1,600 ft. of 36 in. by 24 in. egg shape reinforced concrete pipe.

### CONTRACTS AWARDED

**Edmunston, N.B.**

John F. Martin has general contract for construction of pumping station costing $30,000 for Town.

**Halifax, N.S.**

General contract for laying water pipe for Dom. Govt., Dept. Naval Service, is awarded to Nick Dasckallino, 10 Compton Ave.

**Hamilton, Ont.**

City Council plans construction of asphalt pavement on King St. at cost of $42,000, and on Rebecca St. at cost of $40,000. E. R. Gray, Engr.

**Quebec, Que.**

General contract for construction of road at cost of $44,000 for City is awarded to T. E. Rousseau Ltee, 229 St. Joseph St.

**Toronto, Ont.**

York Twp. Council awarded general contract for construction of watermains on Hillary Ave. costing $11,500 to Gordon Thompson, care of F. Barber, Engr., 40 Jarvis St.

**Toronto, Ont.**

Dept. Pub. Highways, Prov. Govt., awarded contract No. 457 for concrete pavements costing $52,000 in Sandwich and Sandwich South, Ont., to Johnson Bros., Ltd., Branford, Ont.

Contract No. 456 for concrete pavements costing $39,000 in Chatham Twp., for Dept. Pub. Highways, Prov. Govt., is awarded to N. P. Godson, 30 Leopold St., Toronto.

### Railroads, Bridges and Wharves

**Aylmer, Que.**

Hull Electric Rly. Co., Main St., Hull, Que., contemplate improvements to track, roadbed, etc., at cost of $10,000.

**Allenford, Ont.**

Amabel Twp. Council will ask Prov. Dept. to prepare estimates for new bridge. Repairs to several twp. bridges are also contemplated. Geo. C. Wain, secy.-treas.

**Port Hood, N.S.**

R. C. Desrochers, Secy. Dept. Pub. Works, Ottawa, will receive tenders until Sept. 13th for repairs to wharf. Plans at offices of Dept., and Dist. Engr., Halifax; also at P.O., Port Hood. Accepted cheque for 10 per cent. of tender required.

**Prince Rupert, B.C.**

H. A. Dixon, Chief Engr., Western Div. C. N. Rlys., Winnipeg, has plans and will receive tenders until Sept. 7th for erection of warehouse. Plans also with Dist. Engr., Edmonton, Alta.; Div. Engr., Calgary, Alta.; Asst. Engr. Maintenance of Way, Vancouver; Acting Dist. Engr., Prince Rupert. Tenders to be made out on forms supplied, and cheque for 5 per cent. of tender, payable to treas., must accompany bids.

### CONTRACTS AWARDED

**Agassiz, B.C.**

W. Greenlees, Vancouver, has general contract for construction of bridge for Prov. Govt.

**Becancourt, Que.**

General contract for construction of steel and concrete bridge costing $58,000 for Council is awarded to Nicolet Construction Co., Nicolet, Que. ....... ... ...

**Gladstone, Man.**

General contract for construction of reinforced concrete bridge costing $11,411.60 for Mun. of Westbourne, Gladstone, is awarded to N. A. Cairn, 509 Merchants Bank Bldg., Winnipeg.

**Montreal, Que.**

G. T. Rly. awarded contracts for paving on Victoria bridge from Montreal to St. Lambert to Wm. I. Bishop Co., Ltd., 10 Cathcart St., and Peter Lyall & Sons Construction Co., Western Ave.

**Sanford, Man.**

General contract for construction of bridges costing $26,287.80 for MacDonald Municipality is awarded to Macaw & MacDonald Winnipeg.

**St. Camille, Que.**

L. Morrissette, St. Camille de Bellechasse, has general contract for construction of bridge. Steel contract is placed with MacKinnon Steel Co., Ltd., Drummond Rd., Sherbrooke, Que.

**Toronto, Ont.**

Toronto Transportation Cmsn. awarded general contract for erection of addition to car barns costing $235,000 at Danforth and Coxwell Aves. to Wells & Grey, Ltd., Confederation Life Bldg.

**Windsor Mills, Que.**

Felix Grise, St. Christine, Que., has general contract for construction of bridge for Town. Steel contract is placed with MacKinnon Steel Co., Ltd., Drummond Rd., Sherbrooke, Que.

**Winnipeg, Man.**

J. H. Simmons, 506 Confederation Life Bldg., Winnipeg, has general contract for erection of station bldgs. costing $18,000 at Handel and Blucher, Sask., for C. P. Rly.

### Public Buildings, Churches and Schools

**Burnaby, B.C.**

Bowman & Cullerne, architects, 716 Yorkshire Bldg., Vancouver, have plans and will receive tenders until Sept. 6th for erection of school for School Bd.

**Desraeli, Que.**

Erection of school is contemplated by School Bd. Hippolyte Tanguay, secy.-treas.

**Eastview, Ont.**

Erection of school is contemplated by Pub. School Bd. W. S. Kettles, secy.

**Halifax, N.S.**

Plans are prepared for school for Armdale School Bd. A. E. Priest, architect, 89 Hollis St.

**Ottawa, Ont.**

J. Albert Eward, architect, Jackson Bldg., is preparing plans for Collegiate to cost $700,000 for Ottawa Collegiate Bd.

Tenders will be called shortly for erection of bldg. for Ottawa Collegiate Bd. Cecil Bethune, secy.

**Sherbrooke, Que.**

J. W. Gregoire, architect, 16 Wellington St. S., is preparing plans for municipal bldg. for City.

**St. Boniface de Shawinigan, Que.**

R. C. Congregation will erect church at cost of $125,000. Jules Caron, architect, 21 St. Joseph St., Three Rivers.

**St. Francois, Que.**

School Bd. contemplate erection of school. A. Doyon, secy.-treas.

### CONTRACTS AWARDED

**Canyon City, B.C.**

Geo. Hendren, Creston, B.C., has general contract erecting addition to school for Prov. Govt.

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## *The Pendulum Swings Back*

"Commerce Monthly," a journal published by the National Bank of Commerce, of New York, from which we have occasionally quoted, now definitely states that business conditions are improving. In their last issue they report editorially as follows:

"Business conditions reflect more clearly than a month ago the improvement then underway, though it was then, as now, somewhat obscured by the usual midsummer dullness. The increased availability of credit and the marked declines which have taken place in money rates in the last six months are among the surest evidences that the betterment is founded on improved fundamental conditions."

The editorial points out that so far as basic raw materials are concerned, the process of deflation has been fairly thorough. Prices of most of the commodities now approximate pre-war levels, declines in many cases amountng to about two-thirds of the peak prices. It is pointed out that the wholesale price indexes of the United States Bureau of Labor Statistics indicate a decline in the general wholesale price of 45 per cent, between May, 1920, and June, 1921.

Regarding money rates, the opinion is offered that business operations at this time should be based on probable continuance of rates at levels not far from those now prevailing.

A general decline of 45 per cent. in the wholesale price of raw materials should mean a very close approach to the pre-war cost of building, if the price of labor could be brought into line. Labor, hwever, is arguing that retail prices have not kept pace with the reduction in wholesale prices. If this is so, and there seems to be considerable evidence that it is, then the renewal of business activity is being delayed mainly by that part of the population engaged in the retail buisness. When the retailer is able to reduce his price more nearly in line with the reduction in wholesale prices, so that an appreciable reduction in the cost of living will make it possible for labor to accept reduced wages without in any way reducing their standard of living, then it would appear we shall be in a position to resume our normal activities.

## *Plans for Increased Building Activity in Victoria, B. C.*

Plans to encourage the resumption of building in Victoria, B. C. on an extensive scale are being considered by the local Chamber of Commerce which has been asked to co-operate in this scheme with the Canadian Founders and Metal Trades Association. It is felt that the Chamber could be useful in doing away with the misapprehension with regard to building prices which exists in the public mind and which causes everyone to wait for the other fellow to start building.

While there still remain some revisions in material prices and wages to be made, the Founders and Metal Trades Association believes that the aljustments in this direction already made are so extensive as to warrant the placing of contracts which will tend to a resumption of business activity. Its views are set out in the following letter which has been received in Victoria:—

"Industry in Canada to-day is dormant and industrial plants are, in many cases, either closed down or or operating short time and short-handed. Unemployment is abnormal and appears to increase. The hopes of everyone are centered upon an immediate resumption of business and a gradual return to healthy normal conditions. Manufacturers are being asked daily to quote upon a great volume of business, but no order of any consequence are being placed. In some instances Canadian business which should be kept within Canadian borders, at least until our own industries are on a normal basia, is being placed with the United States firms.

"It is highly desirable to maintain amicable trade relations with the United States, but until this crucial period is past we believe Canadian manufacturers should have the preference so far as possible. Our manufacturers are eager to keep their places in operation. Wage earners are eager to have employment. Revisions downward have been made all along the line in material prices and wages, but everyone apparently is waiting for the other fellow to take a chance. It is up to the investor, the buper, to stimulate the situation, encourage the development of Canadian industry, and through it the growth of Canada as a nation by placing every pending contract with some Canadian firm immediately."

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The Anti-Corrosion Engineering Company, New York City, are issuing folders on "Deoxidizing Deactivator for Preventing Pipe Corrosion" and "Deaerating Apparatus for Preventing Pipe Corrosion." Both folders devote much space to the working principles, installation and construction of these machines.

West elevation of the Hospice du Sacre Coeur, Sherbrooke, P.Q., showing the front part of the building with the right and left wings.

# Noteworthy Building Addition at Sherbrooke, P.Q.

## Hospice du Sacre Coeur, Extended at a Cost of Four Hundred Thousand Dollars, Now Nearing Completion—Features of Design and Construction

There is now nearing completion at Sherbrooke, in the Province of Quebec, a noteworthy addition to the Hospice du Sacré Coeur, the constructional cost of which is estimated at $400,000.

From the views presented herewith it will be seen that the new building has been erected as an addition, although it will be apparent that the new part is several times the size of the old, and that in reality the undertaking constitutes an entirely new building, of a more or less monumental character.

The building is designed in the form of a cross, and contains four storeys and basement, exclusive of an extra storey on that part of the building which is to be used as a sanitorium.

The construction is of brick with granite trimming from the Norton Quarry at Stanstead. The floors are of concrete, reinforced with triangular mesh wire. Plain round bars are used in beams and columns. The general span of the beams is 25 ft., and 38 ft. over the chapel. The inside partitions are built of 4 in... terra cotta, and the outside walls are lined with 2 in. terra cotta.

The building is designed to accommodate seven hundred orphans and old people, and is divided into wards

South-west elevation of the building

with such accommodation in view, provision being made for male and female wards, and also for private rooms. There are play-rooms and class-rooms for children, and also kitchenettes and dining-rooms in each section. A large chapel is included in the accommodation.

The sanitary equipment of the building is on the most up-to-date lines, special attention having been given to the hot water heating and to the ventilation of the building.

There are verandahs twelve feet wide, of concrete construction, on each floor at each end of the right and left wings. These verandahs are supported by strong brick piers. The stairways and landings are in concrete, with iron stairs and slate treads. The floor surface, including basement, comprises 160,000 sq. ft. There are 75,000 ft. of terrazzo flooring. The roof is of gravel. Passenger and freight elevators are installed.

The length of the building is 265 ft., the depth the same, and the width 60 ft.

The architect is Mr. J. W. Gregoire of Sherbrooke, who designed the undertaking for the Grey Nuns. The general contract is being carried out on a percentage basis by Mr. Alf. Dion of Sherbrooke. The brick was furnished by The Laprairie Brick Company, Limited, and the terra cotta by The Citadel Brick & Paving Block Company, Limited, of Quebec City.

The engineers for the heating are The Canadian Domestic Engineering Company, Limited, Montreal, while the heating and plumbing installations are being made by Oliver Trudeau of Sherbrooke. The contractor for the stone cutting is G. Ulamondon of Sherbrooke, and for the terrazzo and marble, The Lepage Marble Works, Limited, Montreal.

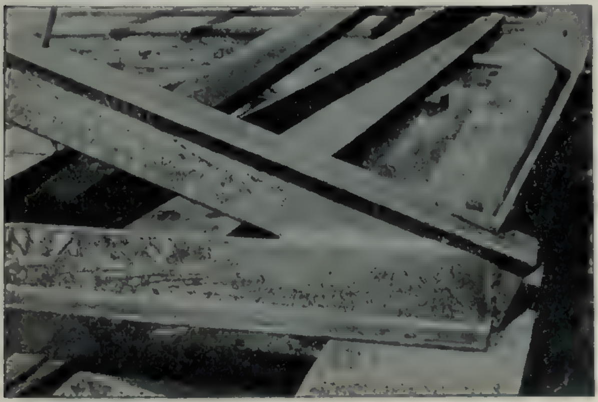
It is hoped to have the building practically completed by the end of this fall and in occupancy next spring.

# Arc Welding Supplants Rivets for Structural Steel Work

## Successful Demonstration of the Use of Welding Methods in Steel Construction Gives Promise of Wider Application of the Idea in the Near Future

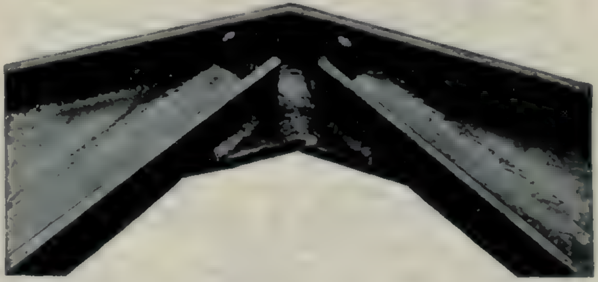
That arc weldng is continually finding new and important industrial applications is being demonstrated by numerous reports of successful welding. In a recent publication issued by the Westinghouse Electric & Manufacturing Company, entitled "Arc Welding Applications," many interesting and novel uses of arc welding are explained and illustrated.

One of the applications shown is the first structural steel building ever erected without the use of rivets. The electric arc was employed throughout the entire construction to unite the structural steel members. Inasmuch as the entire construction was tested and approved by the New York Bureau of Buildings, the arc welding process for this line of work has passed from the experimental stage to the practical commercial stage. The trusses are designed for a live weight of 40 pounds per square foot, each truss supporting a panel of 800 square feet. They were tested to a load of 120 pounds to the square foot, or a total of 48 tons on the two trusses.



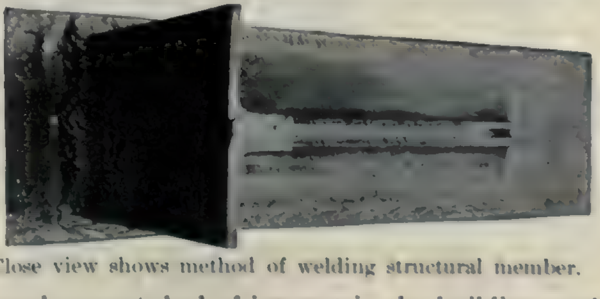
Electric welded roof trusses of 40-ft. span.

The main advantage of arc welding, for this work, are the elimination of the neccessity for fabricating the steel parts and the saving of time in waiting for the girders to be fabricated. Another decided advantage of the arc welding method over that of rivetting is that it does away with the noise of rivetting and makes it possible to work day and night without causing any disturbance.



Sample of welding at ridge of structure.

This unique example of the use of welding has aroused a great deal of interest in the building trades and industrial plants. Although no extended use of this principle has been made as yet, it is quite possible that great development may be made in the near future.



Close view shows method of welding structural member.

# Wetness versus Fatness

## A Discussion of the Desirability of Adding Lime to Concrete

**By L. H. Hart, Manager, Construction Service**
**National Lime Association, Washington, D. C.**

Every brickmason knows that lime gives to mortar a quality that no amount of water or cement can give, "fatness." This quality is desired both because it makes the work easier, and because it makes better work. It also gives strength to the structure because the bricks are bottom bedded and the passage of fire or air through the wall prevented for the same reason. Fat mortar is so important to the bricklayer, that more than one strike has occured when other mortars were specified, and in fact, the desirable properties of lime are such that it is a rare case where some lime is not used, even though the specifications call for other materials.

Fatness is still more important in concrete, for sand, stone and cement are naturally very short, harsh, rough and hard to handle. It must be dumped clean from the mixer, conveyed in buckets, buggies or barrows, and sometimes in chutes or trucks for long distances, without separating or "segregating." It must then flow into narrow forms, around steel bars in complicated mats, electric conduits, odd shaped frames and sharp corners, all without leaving stone pockets or bubbles, and must show a smooth surface when the forms are removed.

In all parts of the country, practical men tell us that hydrated lime added to the cement improves concrete at all these points, and its use for this purpose consequently has grown rapidly. But this quality of "workability," so much desired and sought after has never been defined or measured. Many attempts have been made to measure it, such as the slump tests, the flow table, and the angle of flow in chutes, but each has a fatal defect, namely, that any desired reading can be secured by adding water. However, segregation is increased, strength is reduced, and fatness is not gained by addition of water.

The recent tests by Professor Abrams of Lewis Institute, are the most pretentious series ever run on the effect of hydrated lime in concrete. They purport to eliminate all the variables except **strength**, and measure that. The tests may be divided into two groups—hydrated lime added **dry**, and hydrated lime added **with water.** In the case of dry additions, the strength is greatly increased but the results are dismissed by Professor Abrams with the statement that the consistency was changed the batch being too dry too work.

That strength can be increased in this way is evidenced by the following statement of Colonel H. C. Boyden, expert lecturer for the Portland Cement Association: "The use of more cement (than the ideal amount) in a batch, does not produce any beneficial effect, except from the fact that a plastic, workable mix can be produced with a lower water-ratio. The reason that a rich mixture gives a higher strength than a leaner one is not that more cement is used, but because the concrete can be mixed with a water-ratio which is relatively lower for the richer mixture than for the lean one. If advantage is not taken of this possibility of reducing the water-ratio the additional cement in the richer mixture is wasted."

When both water and hydrated lime were added, the workability was much improved, but this fact is not made plain. The water allowance was proportioned by the Vicat needle test for normal consistency. This, however, reveals nothing as to workability. Neat lime specimens, reading the same by the needle, may vary extremely in workability themselves, and have widely different effects in this respect on the concrete to which they are added. In short, consistency, which the Vicat needle measures, is entirely different from "fatness."

Further on the author reports figures which he maintains are an index of "plasticity" in concrete. In the Abrams tests, concrete of unit consistency is defined as that which slumps ½ in. to 1 in. in a cylinder 6 in. in diameter and 12 inches high, but the very first group of five specimens slumped an average of 6.2 inches and the whole results of the slump tests when plotted graphically, looks like a crazy quilt, having no rational trend whatsoever. The American Society for Testing Materials has abandoned this form of cylinder and adopted one with a ½ in. taper, but while this will eliminate some of the minor objections to the test, the most important one remains, namely, it does not measure the right property, the one in which concrete men are interested.

There have been attempts to support these contentions with the tests of Professor H. H. Scofield of Cornell University. He states in his report, however: "The degree of wetness in mixing was medium and judged by th eye in each case being constant for all mixes. No attention was paid to "workability" or "water-ratio" at the time of mixing the mortars."

"Workability" is the best word yet devised for the desired property, for "plasticity" and "flowabiliy" cover only part of the meaning while "consistency" refers only to "apparent wetness;"—but "workability" like "strength," has a wide application. "Strength" may mean compression, tension, torsion, shear, bending, or other combinations. In the same way "workability" includes easy dumping from the mixer, bucket, hopper or buggy, proper flow down a chute, around reinforcing and other obstructions into complicated forms and sharp corners, freedom from segregation, and from stone or water pockets, easy tamping and easy finishing under the machine or trowel. Up to the present time this quality has been one of those which are said to be incapable of expression in English but "one must **feel** it with his tool."

This attitude however, is destructive of progress, and we can never advance unless we make the attempt to define and measure these variables, however elusive they may be. Here is a problem worthy of the mettle of the finest minds in concrete engineering, and should attract the eager hunter of new truth. I maen tahat what is wanted is not support for some pet theory, or advertising for some material, but the whole truth, rrespective of its effect on any material; for only the truth can benefit the public at large, and in the end it is certain that the scientific facts will govern the practice to which manuufacturers must conform.

Let us then continue the effort to define and measure "fatness" in concrete, knowing that what is common knowledge among the trade must, sometime, yield to scientific investigations, and that the knowledge then secured will be of inestimable value to industry.

# Straw Filters for Sewage Purification

## Experimental Work Demonstrates the Value of Straw as a Purifying Agent—Details of Trial Installations

By E. H. Richards anb M. G. Weekes, before the Institution of Civil Engineers.

It is universally recognized that the systems of sewage disposal in general use among civilized communities are very wasteful from the agricultural point of view. Only a minute fraction of the fertilizing value in waterborne excrement is returned to the soil, and even this small portion is generally confined to insoluble matter or sludge, of low manurial value. The latest process of sewage treatment by activation promises to improve the quality of sewage sludge very considerably, provided that it can be dried economically, but this process seems to do little more than the older methods such as percolating filtration, in the way of recovering the most valuable part of sewage.

On the average, three-fifths of the nitrogen in sewage consists of ammoniacal compounds derived from urine. Owing to the great dilution of the ammonia no practical method has yet been devised for recovering this nitrogen. In efficient purification works most of the ammonia is oxidized to nitrate and flows away as effluent to the sea, while the rest is discharged into the air as nitrogen gas. This applies in varying degree to all purification processes, including activated sludge.

Agricultural bacteriologists and chemists have known for many years that micro-organisms commonly found in the soil are capable of assimilating ammonia and converting it into some insoluble organic form, probably, in part at any rate, as portein of their own bodies.

Recent researches carried out by Hutchinson and Richards at Rothamsted Experimental Station on the fermentive changes of nitrogen and carbon, which are of fundamental importance to agriculture, have indicated a means wereby the highly dilute ammonia of sewage may be recovered and made available as manure.

### Laboratory Experiments.

The laboratory experiments which led to he construction of the straw filter at Wainfleet were briefly these:—

A dilute solution of ammonium carbonate, of strength equal to a very strong sewage—i.e., 10 parts of nitrogen per 100,000, was passed through a percolating filter of wheat straw at the rate of 250 gallons per cubic yard of straw per day. On the first day 5 per cent of the nitrogen passed on to the filter was removed, the amount increasing steadily up to the twentieth day, when only 1 per cent of the nitrogen in the artificial sewage was found in the effluent, the remaining 99 per cent. remaining in the filter. The filter was then mature and continued to remove practically all the nitrogen fed to it until the saturation point was reached.

In the case of wheat straw the filter continued to remove nitrogen until 7 parts has been fixed per 1,000 parts of dry straw. On dismantling the filter the straw was found to have retained 86 per cent of the nitrogen contained in the original ammonia solution. Twenty per cent of the dry matter in the starw had disappeared in the process of fixation, so that the nitrogen in the final dry matter had been raised to 1.33 per cent.

The effluent was brown coloured but non-putrefactive. It contained too much carbonaceous matter in solution to pass the Sewage Commission's test for dissolved oxygen absorption. When the straw filter effluent had run through an ordinary clinker percolating filter,an effluent was obtained that would pass both the standard tests, but was still very brown in colour.

The experiment was then repeated with actual sewage from the Harpenden Works. The results were the same as in the first experiment.

LABORATORY STRAW FILTER AND AMMONIUM CARBONATE.

*Nitrogen Balance.*

| | Grammes. | | Grammes |
|---|---|---|---|
| Nitrogen added as $(NH_4)_2CO_3$ .. | 1·400 | Nitrogen in effluent . | 0·121 |
| Nitrogen in straw at start | 0·759 | Nitrogen in straw at end | 1·965 |
| | | Nitrogen lost (3·4 per cent) | 0·073 |
| | 2·159 | | 2·159 |

Amount of added nitrogen fixed 86 per cent.

LABORATORY STRAW FILTER AND SEWAGE.

*Nitrogen Balance.*

| | Grammes. | | Grammes. |
|---|---|---|---|
| Nitrogen as $NH_3$ in sewage .. .. .. | 1·532 | Nitrogen in effluent .. | 0·149 |
| Nitrogen in straw at start .. .. .. | 0·877 | Nitrogen in straw at end | 1·976 |
| | | Nitrogen lost (11·6 per cent) .. .. . | 0·284 |
| | 2·409 | | 2·409 |

Amount of added nitrogen fixed 72 per cent.

When the straw has become saturated with nitrogen it can be removed from the filter, and if stored in heaps will continue to ferment with great improvement in its physical state regarded as a substitute for farmyard manure.

At this stage of the experiment (May, 1919) Richards and Hutchinson chanced to meet Mr M. C. Weekes, then Chief Engineer to the Board of Agriculture, who was faced with the problem of providing some method of sewage disposal for a hutted camp of 300 navvies to be engaged of the Board's land reclamation scheme on the north-west shore of the Wash. Only urine, cookhouse and ablution shed water would need treatment, but the concentration of the sewage liquor would probably be excessive, and liquors of this nature do not yield readily to treatment on percolating filters.

As the experiments described above had just been completed, the possibilities of a straw filter were discussed and ultimately a scheme on these lines was put into operation.

### Straw in Sections.

The original experiments had made it clear that clean straw was not active in removing nitrogen, but that it gradually became more so as sewage was passed through it, the best results being obtained after 20 days of treatment; for this reason it was decided that the filter must be in sections and that the straw must be passed from section to section so that the sewage always met the newest straw first and finished by passing through the most active section. It was also decided that three sections would be sufficient, as this would give one section fully active and another nearly so, when clean straw had to be added. The first intention was to construct three shallow beds arranged in steps but when the details came to be got out, it was found that the head required to give three systems of distribution was too great to make the scheme practicable, and further that there would be considerable labour in working the straw from one bed to the next.

Finally a filter was constructed as follows. An angle-iron frame-work, 20 ft. long, 10 ft. wie and 7 ft. 6 in. high, was fixed over a sloping concrete floor, with two main horizontal members, one 2 ft. and the other 4 ft. 6 in. above the floor, passing along each side. On these members 1 in. diameter galvanized iron pipes, 12 ft. long, were laid, spaced at 4 in. apart, centre to centre; the length of the pipes allowed them to project 12 inches beyond the frame work at each end to the bed 3 ft. above the upper of the two floors to give a hand-hold for drawing.

Transverse horizontal angle-irons were fixed across the bed ' ft. above the upper of the two floors so formed, to tie the verticals together and also to carry the distributing troughs. Two V-shaped wooden troughs were laid over the filter, the sides having notches about 12 in. apart with a nail driven under each to act as a drip point.

This type of construction made it very easy to pass the straw from section to section of the filter. When the ripest straw had been raked out from the bottom layer, the attendant would begin at one end and draw out each pipe in turn until the whole of the straw that had been the second layer had fallen on to the concrete floor. He would then replace the pipes and draw those from under the top layer, letting that down in turn. The upper pipes were then replaced and the new straw unloaded from the carts on to them.

No trouble was experienced in pulling out the pipes, as the friction against the wet straw was very slight.

The spacing of the pipes supporting the straw proved to be about right, there was little sagging down between the pipes, and the distribution for one layer to the next was quite good as the sewage came through in drops. The distribution from the troughs was very faulty at first, until the attendant got used to keeping them adjusted and cleaning the notches, but later it was sufficiently good for this layer, which is not really operative, but merely being prepared to become so.

The pump that fed the filter could not be worked at a slower rate than about 17 gallons per minute. This would not have given too quick a rate of application had both units been in use, but with only fifty gallons storage capacity in the tank first installed it was too fast for one filter. Moreover, it took some time to persuade the pump-driver that the rate of pumping really mattered, so that at first he ran his pump as fast as possible unless he was watched, and the actual rate of application of the sewage was as high as 450 gallons per cubic yard per day, instead of 60-80 gallons required. Under these conditions it is not surprising that the actual removal of nitrogen by the filter was very small. But even then the effluent was free from smell, and neither at this or at any subsequent time was there any nuisance from the filter itself or from the ditch receiving the effluent, nor did flies collect around the filter. The rate of flow to the straw was gradually reduced to 96 gallons per cubic yard per day by restricting the tank outlet pipes with a corresponding improvement in the nitrogen recovery. The best purification, as measured by five days' dissolved oxygen test, was 80 per cent. Negative purification was generally shown by four hours permanganate.

### Improvement in Nitrogen Recovery.

When a new tank of 960 gallons capacity was installed, the improvement in nitrogen recovery was very marked. The best figure recorded was 65 per cent of the nitrogen in the sewage. On incubation for five days the effluent was invariably putrid. From such a strong liquor, ten times as strong as normal sewage, it is probably impossible to produce a non-putrescible effluent by straw filtration alone.

### Wainfleet Straw Filter.

Average analyses of samples taken after installation of larger overhead tank, July-September, 1920.

| | Parts per 100,000. | |
|---|---|---|
| | Sewage. | Effluent. |
| Ammoniacal nitrogen | 18.92 | 10.19 |
| Oxygen absorbed in four hours from permanganate | 31.88 | 20.82 |
| Dissolved oxygen taken up in five days | 80.4 | 14.9 |
| Chlorine | 31.0 | 39.3 |

| | Dry matter. Per cent. |
|---|---|
| Total nitrogen in raw straw | 0.50 |
| " " in straw removed from filter | 1.62 |
| " " after storage for six months | 2.06 |

In order to recover all the nitrogen possible about 2 lb. of dry straw per man per day is required. During the year's working at Wainfleet the amount of straw used was considerably less. For a period of thirty-five days 2,800 lb. of nitrogen was pumped on to the straw in the sewage. The weight of straw shown by laboratory experiments as necessary to recover this amount of nitrogen is 5,000 lb. Even if the rate of flow had been low enough to allow proper biological action, only about half the nitrogen could have been recovered. The straw removed was in fact, overloaded with nitrogen all through the experiment. The resulting manure, after storage in a heap alongside the filter, was of excellent quality, containing 2.06 per cent. of nitrogen, and was in good condition for applying to the soil. This manure has no smell whatsoever.

The practical application of this process is so far limited to such sewage works as have access to straw in quantity and where a demand exists for farmyard or stable manure which canot be met at present. There are, however, many places in this country where these conditions now exist, while the supplies of stable manure are rapidly diminishing.

Straw is by no means the only substance suitable for the process, and further research may show how the less digestible carbo-hydrates in sawdust and other vegetable waste products may be made available.

## DEFECTS IN GLAZED WALL TILES.

Glazed wall tiles are sometimes found to become seriously cracked after being in use for a short time. This may be due to various causes, including:—

(1) Defects in the tiles.

(2) Faulty conditions to which the tiles are exposed during use.

Where cracks are due to original defects in the glaze, the cause must be sought by investigating the latter. Hair cracks in the glaze are caused by the unequal contraction of the body of the glaze, and are usually remedied by adding a small quantity of flint to the glaze prior to its use, so as to reduce the contraction of the glaze. In most cases fine hair cracks are not very noticeable and are often unavoidable, but if they become large a different glaze is necessary. Where the cracks are large, the cooling of the glazed tiles may also be at fault. It may be desirable to cool the kiln more slowly in future. If the glaze is applied too thickly on the body of the tiles, cracks are almost certain to occur when the tiles are heated, on account of the uneven expansion and contraction of the glaze and body. Too thick a coating of glaze may be due to carelessness on the part of the workmen or to the use of too thick a slip for coating. In either case the remedy is obvious, i.e., a thinner slip applied thinly and evenly to the surface of the tiles. A thick coating may also be caused by the presence of too much clay in the composition of the glaze. This makes it of a thick, creamy consistency, and unless brought to the correct consistency for coating, an excessively thick layer may be produced. Where it is necessary to add clay in order to adjust the composition of the glaze, it is desirable to add it in the form of a feebly plastic or non-plastic material, such as china clay or finely burned clay. Ball clay is too plastic; it is often detrimental to the quality of the glaze slip and may cause craking or "balling" of the glaze. This latter defect may also be caused by not heating the glaze to a sufficiently high temperature or by heating it too long. As this difficulty is more frequently found in connection with green tiles which have been glazed before being burned, it is always wise to apply the glaze to the biscuit ware where this can be done economically.

The tiles may also become cracked on account of the methods il laying then or the conditions encounterin use.

Where a very rich cement is employed for laying the tiles, it is very probable that they will craze when they have been in use for some time, because the cement, on hardening, causes a gripping action on the back of the tile. This puts a strain in the thin layer or coating of glaze, and eventually it cracks. In order to avoid this difficulty, it is desirable to use a considerable proportion of sand in the cement used for fixing the tiles. The idea that the larger the proportion of Portland cement in the mixture the better will be its quality is a serious mistake, and for the reason just given, tiles should never be laid with a cement containing less than 80 per cent of sand.

The conditions to which tiles are exposed in use have much to do with the wearing power of the tiles. If they are exposed to the open air, they are liable to craze in winter on account of the repeated freezing and thawing to which they are subjected, whilst acid charged rain, sand blown about in the air and other influences all tend to reduce the life of the glazed tiles.

In the interior of buildings the tiles last much longer and are more durable, though in fireplaces they may craze or crack on account of the alterations of temperature.

## Have Not Closed Up Business

In a recent issue we announced that the Cooksville Shale Brick Company, Ltd., had closed their plant temporarily. In order that there might be no misunderstanding, however, we should have pointed out that this company has not discontinued operations but is merely suspending manufacturing owing to the fact that their storage space is congested with stocks of brick. They are in a position to take care of all orders promptly and are retaining their organization in order that they may resume work as soon as this situation has righted itself.

## Alberta's Irrigation Work in Full Progress

J. W. Mitchell, Director of Alberta Government Employment Bureaus, has just returned from a lengthy trip over the irrigation district in Southern Alberta.

Mr. Mitchell's trip was made with a view to geting first-hand information regarding the irrigation project. Starting at the intake, near Mud Lake, where the right of way is being cleared preparatory to a large dam being erected, and going along the line to Campbell Bros., he found another camp where there were five dinky engies, a number of cars and a steam shoved outfit with a lifting capacity of 2½ yards, the weight of soil being 1,700 pounds to the yard. The dirt is taken from there by trains moving continously, and deposited over a trestle built for the purpose. Going from there to Larson's Camp, other steam shovels were found in operation. Further on, after passing six large outfits, came Jackson headquarters, which are situated at Nobleford. There are fifteen sub-operators working for this firm. Still further along the line was the headquarters of Norhern & Mannix, which firm has fifty sub-contractors. The preparatory work is, to some extent, over, although a number of steam shovels are still being installed. When one realized that 20,000 yards a day must be moved between now and May, 1923 some idea of the magnitude of the undertaking is apparent.

Mr. Mitchell is reported to have made a thorough investigation with regard to the rumor that many Americans were being engaged on the job. Out of some 70 or 80 contractors, it is said there are not more than ten Americans employed.

The orders have been very positive that so far as possible preference be always given on the work to Alberta men. There are a large number of returned men engaged as sub-contractors, so far as is known, who belong outside the province of Alberta. As a matter of fact, Mr. Campbell, prior to this, had given positive orders that he would O.K. no bills for goods contracted for outside Canada that could possibly be obtained in this country.

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Work on the extension of the engine room in the engineering building of the Saskatchewan University, Saskatoon, commenced a short while ago and isproceeding rapidly. The Dominion Bridge Co. has the contract to erect the steel frame. Carter, Halls and Aldinger, Winnipeg, will do the building work. E. S. Houck, the engineer who has been in charge of the C. N. R. Bridge construction, is also directing the steel work at the University. He stated that the work on the extension would probably be completed about the end of September. The steel frame for the first floor and the columns which will support the roofing are already erected. The dimensions of the extension are 150 feet by 70 feet. The total weight of the steel to be used is 80 tons.

# Cheaper Instead of Greater Production

## How Manufacturing Organization is Analyzed with View to Bringing Down Costs—True Value of Accurate Costs

By William Snaith, C.E., Associate Engineer with Forests Products Engineering Co., Chicago.

The article by Mr. E. W. McCulloch in the July 13 issue of the Contract Record and Engineerig Review p. 653, on the "Distribution of Burden of Good and Bad Times" is by far one of the best discussions of a very timely subject. The writer is heartily in accord with the principals so well stated in the article. If it were not for the fact that it is the exception rather than the rule to find these principles adopted it would not be worth while to thus express agreement. The advocate of such methods is more likely than not to get a cold reception in the average manufacturers accounting office. Probably this arises somewhat because slightly more work is involved, but mainly because the accounting methods of the average business man have a long way to go before they come up to modern standards. Few realize that in the last decade or so accounting science has practically been remade. The coming of the Income Tax and other similar afflictions will perhaps turn out to be very much in the way of blessings in disguise if they lead to better methods of keeping records in the business world. It may not be too much to expect that the economies they will lead to will more than offset the actual outlay of money they call for.

It has been proved in numerous cases that a business with old-fashoned methods of accounting can go on showing profits while actually losing enough to wipe itself out in ten or twelve years. As soon as such a condition is revealed to the average executive he will turn to a Cost System like a drowning man clutching at a straw and it will likely stand him in as good stead. This is not said with any idea of belittling cost systems. They are as necessary as any other of the accounting records of a business but they are not cure-alls. One of the latest to join the division of the new science of accounting, they really are yet in process of digestion by business. Far too much has been claimed by some of the experts making a speciality of such systems and there is perhaps something of a reaction against what the average man feels is "red tape."

### Bringing Down Costs.

It is not proposed to point out defects in cost systems or to explain why some of them have faied. It is a difficult thing at best to start any new idea and the process is one of trial and error to a large extent. The purpose of this is to emphasize the fact that more than a cost system is required by the average manufacturer at the present time. A cost system is part of an accounting system. The accountant keeps the records of the business, and Mr. McCulloch's article will guide the accountant to a more accurate record of one phase of his work. The article just touches on the fringe of another subject which is however, not lacking in interest and that is: How to lower costs in the face of falling demand, falling prices and with overhead not falling at all.

Just how seriously this question is being considered can be judged from the fact that in February of this year it has been estimated that one-third of the business houses of America were potentially insolvent in the sense that they could not possibly have paid their current debts. In Canada and the United States nearly four and a half million people are are out of work and there are other evidences of the depression which surrounds us. There may be good reason to believe that the worst is over, but there is a long pull ahead before times will justify the epithet "good."

What the manufacturer wants to know is how to make whatever he produces for less money than he ever did. To lower costs is his obession and the thing he thinks of and must think of all the time. His cost system is very likely telling him that in spite of some increase in the efficiency of labor his unit costs are not coming down very fast. The workman is on the horns of a dilemma. If he hustles and finishes all the work in sight he'll be laid off; if he dosen't hustle he'll be replaced by one who will. We are all human and any of us under these crcumstances would compromise. A lot of bad habits engendered by the war conditions of the past years when production practically regardless of cost was the rule, are with us yet. These must be eradicated and yet we have become so accustomed to some of them they seem only necessary evils.

### Cheaper Not Greater Production.

"Cheaper production" takes the place of "more production" as the password to success. To the industrial engineer rather than to the accountant must business, and especially the woodworking industry, turn at this juncture. The accountant is giving business better records than it ever had but more than records is required. The industrial engineer brings to the problem of cheaper production the scientific methods of analysis and standardization, followed by a properly designed system of production control and a wage payment system where reward is in proportion to skill and work done.

Production readily stands first in the four divisions of business—production, finance, accounting and selling. It is the foundation on which the others build. Without production there is nothing to finance or sell and no need of records or accounting. Cost of production can not be lowered by the best system of records that the most brilliant genius can devise. If the cost of a piece of work is to be reduced it must be done before the work is started. Some saving may be possible while the work is underway but none at all when it is finished. Many a job which was started right has been spoiled when nearly finished by attempting too late to keep the cost within an estimate which was too low to begin with.

Records of past performance can be used in estimating future work only, (a) if the conditions have not been changed and (b) if the records are accurate and dependable. It is the exception rather than the rule for either of these conditions to be fulfilled. More especially is it exceptional for the records to be either accurate or dependable and when they cannot be relied on they are really worse than useless. Inaccurate cost data can only lead to inaccurate estimates. But even if both conditions are fulfilled to perfection the most that can be hoped for will be that costs will not be higher than they were. There still remains the possibility which amounts almost to certainty that the old costs were unnecessarily high. What is lacking is a standard wherewith to measure performance. We can estimate with precision how much material will be required to make a certain article of furniture but when it comes to the labor cost we have not the same exact basis for our figures. We know (if our cost records are accurate) that a somewhat similar thing cost us so much at such a time for labor. Could another shop do it for less? They couldn't use less material, but could they put less labor on it? What should be the minimum labor cost? To supply the answer to these queries is the function of the industrial engineer.

### Analysis of Product.

The first step in studying production is to know what is to be produced. This may sound somewhat trite, but the mere cataloguing of all the articles to be made in an average plant serves several purposes and will likely reveal some such conditions as these; some old lines which are obsolete and should be dropped, several articles which are so nearly alike that it is unprofitable to continue the distinctions; the main product for which the demand is known and new lines for whch demand is to be created. This list will vary from one single article to several hundreds of thousands with the size of the business. After this has been gone over carefully and all deadwood eliminated a list of all the component parts of each article is made. In the discussion of standardization we shall see that as far as possible the designs are modified to permit the same part being used in a number of articles. Our third list gives us all the operations on each separate part in their proper sequence.

A survey is next made of the machines and tools available for turning out the product. The speeds and feeds are determined and the capacities noted. Their condition is investigated as having a direct bearing quality. The layout of the whole plant also calls for study under this head. If possible the raw materials should enter at one end and the finished product leave at the other, but in actual practice this condition is a rarely attained ideal. The extent to which backtracking and unnecessary moves can be avoided is usually considerable. It is to be borne in mind in this connection if the moving of machines is called for that such expense will be incurred but once, while the cost of any additional handling or trucking is a continuing expense which may be sufficient in even a short time to pay for the change.

The study of the materials used and the manufacturing methods used need not be discussed under this head, although their analysis forms a part of the complete analysis of the product. They will be dealt with in connection with standardization.

### Standardization is Foundation.

The foundation stone of modern manufacturing is standardization. It is not enough to standardize the product itself; the methods and machines must be standard also as well as the materials used. To a certain extent the men who do the work must come up to a certain standard, although it is likely that some of the steps in this direction by some authorities go further than is necessary. It is the part of wisdom to select men with some regard to the work they will have to perform, using size and strength for heavy work and skill and experience for the finer lines. It is variously estimated that the cost of breaking in a new employee runs from $50 to $250 and in special cases to much higher figures. Cutting down the labor turnover results in a saving which can almost be measured in dollars and cents.

In the case of materials when once the most suitable material has been found a brief specification covering is prepared and future orders must conform to this. In the case of small parts such as nails, screws, bolts and nuts a complete description is prepared so that no difficulty will be encountered by a firm receiving an order for them in filling. In these days of specialization there are so many varieties of even the simplest things that the chances are multiplied of getting something sufficiently different, although of the same class, for the variation to be serious.

After trying out various methods or different series of operations the best and most economical is chosen as the standard and this will be adopted for all future work until a cheaper of better way is devised. The extent to which it will pay to experiment in determining the best method of performing an operation will depend on the number of times it is performed. In the case of special operations in repetition work where the same operator is constantly engaged on the same operation the ultimate developments along this line is motion study with a motion picture machine. The classic example of painstaking study in determining the best set of motions is the series of experiments by Mr. F. W. Taylor on shovelling in the plant of the Bethlehem Steel Company. When once the best method has been decided on it is written up in the form of standard instructions to govern all future work.

The industrial engineer is not usually responsible for matters of design, but as a general thing the establishing of a system of standards will reveal possibilities of changes in existing designs in the direction of further standardization. The same part can perhaps be made to fit into several articles. Where a varied line of goods has been made for some time without any special attention to this feature the standardizing of designs is likely to result in some surprising economies. It is not at all uncommon to reduce a diversified list of similar parts to one quarter or even one tenth without perceptibly changing the appearance or in any way detracting from the quality.

### Wage Payment Systems.

Nothing else is wasted in a manufacturing plant to the same extent as labor and nothing is paid for on the same unscientific and unfair basis. In buying everything else we know ahead of time what the price is going to be and what quality to expect. In buying labor at so much an hour we may know what quality to expect but the quantity is undetermined. It is unfair to both employer and employee that this should be so. Payment in proportion to value and amount of work done can not be achieved otherwise than by some form of piece work. It is perhaps not too much to say that without standard times in which operations are to be performed and the rates of pay based thereon, it would be impossible to accurately plan the sequence of a series of operations or to make much better than a guess as to the probable cost. What opposition there may be to piece work has its cource, not in anythng inherently wrong in the system, but in the unfair ways in which it is commonly used. Piece rates have been based on past performance without a proper study of that perfrmance to determine whether it represented a fair output produced under proper conditions. Very few men work at a rate more than half of that of which they are capable and the difference btween a man merely holding down his job and another actively interested in getting all he can get out of it is surprising. If now a rate is calculated from the output of an operator working under unstandardized conditions and only moderately interested there can only be two results. The operator with only slightly increased effort and taking advantage of the incentive to devise better methods will increase his production perhaps to double what it was before. The man who set the rate, apart from any criticism he may come in for, is bound to feel that the operator did not previously work at a fair rate and almost inevitably the rate will be cut. This will seem like an injustice to the operator and he will see to it that he does not further increase his production and thus forestall further cuts. Manifestly under such circumstances it is extremely difficult to reduce costs.

It is quite possible to determine the time an operation should take by careful analysis of the motions ar revealel by a time study and after making an allowance for personal time, machine care and incentive, to set a rate which can be guaranteed against change as long as the standard conditions under which the work is to be done are unchanged. If speeds or feeds are afterwards changed or standards of quality are altered the rate is proportionately increased or decreased, but the same financial effort on the part of the operator will result in the same financial reward. If some system of paying for suggestions which result in increased production is used there will exist conditions which are bound to reduce costs and increase output.

Many systems of bonusing all output over a specified task have been devised but all seem to have met with indifferent success. The extra clerical work involved, the smallness of the bonus, the more or less involved calculations, preventing the operatior from knowing from day to day what his bonus amounts to, the use of such terms as "tasks" and perhaps "bonus" itself, have been among the reasons for failure.

In a properly designed piecework system the rates will be equally fair to both employer and employee; the cost of work will be known accurately and in advance; wages can be raised without entailing a revision of the piece rates and old and proven employees will receive a higher wage than new men doing the same work. The result can only be satistaction, absence of labor troubles, reduced turnover and increased production.

### Production Capital.

To really control production so that all necessary parts reach their sub-assemblies at the right time for the sub-assemblies to reach the final assembly in the proper sequence and time is as fine an example of organization as can be found. By anything short of the thorough analysis already outlined and without standard methods it is not too much to say that it is impossible unless the work done is very simple indeed. To explain at any length the actual methods used would take more space than would be justfied in this article. Not only does each branch of industry call for different methods, but the organization of each individual plant must be considered and its pecularites of layout, personel location, and many other things. There are fundamental principals, however, which apply universally and if these are complied with a workable system will be evolved. It is not enough to design the system. A bridge is not built when the drawings are finished, and there is as much labor involved in putting a production control system into operation as in building anything else from plans and specifications.

Above all things, such a system must be flexible. There are always several ways of doing anything and emergencies are bound to arise. The system must not be disrupted if in an emergency standard methods are temporarily discarded and work rerouted through other channels. In fact it is not too much to say that a system is a success in proportion to its ability to handle the unusual in an efficient way and quickly return to normal afterwards.

### Gives Fullest Information.

The production records in the system sketched out above are unusually complete and yet there is no duplication. From them the accountant can obtain costs that can be relied on to be accurate. The selling department can make estimates with certainty. The management can use them as standards wherewith to measure efficiency of departments and men.

To sum up the need of the hour is cheaper production. This will not be obtained by systems of keeping records, necessary though these are. Costs must be lowered before the work is started. By proper analysis, study and standardization of the elements of the product followed by production control costs will be lowered, which is of present interest, and production will be increased, which is of future interest. Incidentally better and more complete records will be obtained and labor troubles will disappear.

## Will Prospect Island Railway Belt

Through its subsidiary corporation, the Consolidated Mining and Smelting Company, the Canadian Pacific Railway Company has undertaken to make a thorough mineral survey of the Esquimalt and Nanaimo Railway Belt of Vancouver Island. Engineers will be engaged to inspect all prospects that have not passed out of the hands of the company and geologists will make reconnaissance of the mineralized zones of this area of over 2,000,000 acres. It is planned to obtain complete information of the mining possibilities of this section. This work will be preliminary to the negotiation of an agreement with the Provincial Government for the elimination of what is described as the "Dual Control of Minerals within the E. and N. Belt."

The Hon. Wililam Sloan, Minister of Mines, has devoted long and careful attettion since 1918 to the problem of bringing the minerals of this belt within the sole jurisdiction of the province. The progress, however, has not been as rapid or as satisfactory as he could have wished because of the reluctance of the C.P.R. to release underground resources without a more exact knowledge of their economic value and potentialities. In correspondence tabled by the Minister in the B.C. Legislature recently, it is indicated that the C.P.R. has come to realize that the present situation—requiring that title to mineral lands within the area must come both from the Province and the Company—cannot continue.

# The Activated Sludge System at Worcester, Eng.

## A Description of the Method of Sewage Purification and the Plant Employed—Continuous Flow Treatment—Handles 750,000 Gallons per Day

By WILLIAM RANSOM, City Surveyor of Worcester before the Institution of Municipal and County Engineers.

It may be of interest to describe the installation which is in operation at Worcester, and which was installed in 1915 by Messrs. Jones & Attwood, Ltd., who were working in conjunction with Dr. Fowler. It has passed through certain experimental stages, improvements have evolved, and the fill-and-draw method superseded by the continuous flow treatment. The writer does not propose to deal with these experimental stages, but to describe the plant as it is in successful operation to-day.

The plant is designed to treat with 750,000 gallons per day, which is roughly three-eighths of the dry-weather flow of the Worcester sewage. Mr. T. Caink, Assoc. M. Inst. C.E., the city engineer, has designed a scheme for the extension of the treatment to the whole of the Worcester sewage. This scheme is now waiting the approval of the Ministry of Health. It introduces many novel features, and it is hoped that the institution may soon have the benefit of a paper by Mr. Caink upon the extended scheme after it has been put into operation.

The existing plant at Worcester has been installed in part of one of the two large disintegrating tanks formerly used in connection with the bacterial treatment. The tank is about 86 ft. long by 78 ft. wide and 18 ft. deep. It is divided into nine longitudinal bays, which are subdivided by three transverse walls, thus dividing the tank into thirty-six divisions, approximately 21 ft. long by 8 ft. wide. Twenty-eight of these divisions have been appropriated to the activated sludge treatment, viz., the aëration tank and eight for the settlement tank. The remaining eight divisions are filled with water in order to equalize the pressure on the division walls. The depth of aërating tanks is an important point for consideration. It has been found that up to about 15 ft. the greater the depth the less is the amount of air required for adequate aëration.

The raw sewage, before it enters the pump well at the works, passes through some submerged screens constructed of expanded metal. The screens, which are in duplicate, are raised and lowered by means of an electric hoist. The detritus which accumulates in the pump well is raised by means of a hydro-pneumatic sludge lift. The screened sewage is raised by centrifugal pumps, driven either by suction gas engines or electric motors, to the aërating tank. Experience has proved in America that where sewage is screened through a mesh of about 3-16 inch diameter it is possible to economize on aëration.

### The Aerating Tank

The raw sewage and the returned activated sludge enter into one bay and circulate through the twenty bays, being agitated and given a rotatory motion by the compressed air which is discharged at the floor of the tank through porous diffusers. The floor of the four bays forming the first longitudinal section of the tank is formed into series of concrete ridges and furrows. The diffusers, which are 1 foot square, are placed in continuous rows in the furrows 5 feet apart, and the discharging air keeps the sewage violently agitated and establishes a continuous circulation as the energy in the air produces motion in the liquid. The other longitudinal sections have floors arranged with furrows 10 feet apart with a corresponding reduction of the amount of aëration. It is thought well to endeavor to give as much aëration as possible to the sewage where it first enters the tank. The transverse walls of the section are used as baffles, while additional wooden baffles have also been introduced, so that as complete a circulation as possible may be secured for the sewage, and no opportunity given at any point for the sludge to settle and accumulate, or for the sewage to be short-circuited and escape proper aëration. If this were to occur the sludge would become septic, and spoil or impede the work of purification. The discharge of compressed air ensures that the activated sludge is equally diffused and kept in full suspension throughout the raw sewage, and that the flocculent matter is broken up into as small particles as possible.

The old tank, which has been converted for use in connection with the activated sludge process, has lent itself remarkably well to the new treatment, and the original design has been easily adapted so as to give the sewage the longest possible period of travel as it passes through the bays.

The compressed air which is discharged from the diffusers is obtained from an Ingersoll-Rand horizontal type compressor driven by an electric motor capable of developing 40 b.h.p. and delivering 562 cubic feet per minute at a pressure of 15 lb. to the square inch, or from a vertical Sentinel compressor which can be driven either by a suction gas engine or an electric motor capable of developing 45 b.h.p. and delivering 500 cubic feet per minute at a pressure of 15 lb. to the square inch.

The actual amount of air now being used is about 360 cubic feet per minute, or about .7 of a cubic foot per gallon, or 1.1 of a cubic foot per minute per square foot of diffusing surface. The pressure of the air at the compressor is 9 lb. to the square inch. The number of units of electricity used per hour amounts to about 11½, which, at 1 1/3d. per unit, is equivalent to about 40s. per million gallons.

The compressed air is delivered into a 9-inch main with 5-inch and 4-inch branches, from which wrought-iron tubes 1½ inches and 1 inch diameter are taken to the diffusers, which are placed at the bottom of the aërating tank. Valves are provided to control different sections of the diffusers.

In some installations the discharge of compressed air is regulated by means of Messrs. Jones & Attwood's patent pulsating gear. The air is discharged in intermittent puffs and the tank is divided into sections whereby each section in turn has a vigorous or concentrated discharge of air, which is a safeguard against any settlement of sludge and ensures a thorough rotary circulation of the sewage.

The design of the diffusers has an important bearing upon the work of aëration. The more finely the air is divided up, and consequently the greater the number of air bubbles, the more economically can the compressed air be used, because in a finely divided state a greater proportion of the air is absorbed or dissolved in the sewage and available for purification. Where the air is discharged in large bubbles or by means of violent ebullitions a greater proportion of the oxygen is lost without doing any work of purification beyond that of agitation.

The diffusers in use at Worcester are constructed of light cast-iron boxes fitted with Messrs. Jones & Attwood's patent porous tile. These are placed with their upper surfaces flush with the bottom of the aërating tank. The porous tile offers little resistance to the passage of the compressed air, but the air is broken up by the granular nature of the material into minute bubbles. No trouble has been experienced with these diffusers, and they have not become choked by the sewage and have never had to be replaced.

In America considerable trouble has been caused through choked diffusers, and favor has been given in some of the small schemes to the pipe grid which can be flushed by water pressure, and connected with the steam supply to remove any accumulation of grease. In the larger schemes filtros tiles are used, which are similar in character to ordinary diffusers. If diffusers do become choked, aëration will be imperfect, and the effluent will quickly deteriorate and become septic. Intermittent aëration is one of the chief causes of choked diffusers.

The ratio of the air-diffusing surface to the tank surface is one for experiment and is found to vary according to the depth of the tank. At Worcester the diffusing surface is about one-tenth of the tank surface. The tank surface is 3,280 super. feet and the capacity of the aëration tank about 317,000 gallons.

In America the tendency has been to use a greater proportion of diffusing surface. At Milwaukee Mr. T. Chalkley Hatton is using a ratio of one to six. In the deeper and long flowing-through tanks it is possible to do with less diffusing surface because the air has a longer period of contact with the sewage before reaching the surface. The area of the tank at Worcester affords when dealing with 750,000 gallons per day an aëration cycle of about eight hours, allowing for the presence of about 20 per cent. of sludge. The length of time required for aëration is regulated by the activity of the bacterial life in the sludge. Agitation of the sewage soon separates and breaks up the colloidal matter, but the bacterial life must be afforded sufficient time to convert ammonia into nitrites and these into nitrates.

### The Settlement Tank

Eight bays of the original tank have been converted into a settling tank with four divisions, giving a settling area of about 1,344 super feet, which is equivalent to about 1 square foot to 560 gallons per day. According to Mr. T. C. Hatton the American practice is to allow 1 square foot to about 1,600 gallons. It has been found that the smaller the area given to aëration the greater should be the area provided for settlement, or, in other words, the shorter the period of aëration the longer is the period required for sedimentation.

The capacity of the settlement tank is about 70,000 gallons, which provides about 1½ hours' settlement when dealing with 750,000 gallons per day plus 350,000 gallons of returned sludge.

The sewage from the aërating tank flows over a weir into a channel leading to the settlement tanks and discharges underneath a baffle which checks the velocity of the sewage. Continuous weirs should be used wherever possible in order to reduce the velocity.

Each of the four divisions of the settlement tank has its bottom sloped at an angle of 60 degrees, and is provided with a sludge lift at the bottom. The sludge lifts are 6-inch cast-iron pipes provided with 2-inch air pipes which discharge into the bottom of the sludge lift, and the sludge is raised into an 8-inch sludge main. The sludge is returned to the inlet channel to mix with the incoming sewage so as to keep the proportion of sludge equal to about 25 per cent., and when necessary the excess sludge is diverted and conveyed to sand beds, where it is dried and disposed of for manure. It is an advantage to re-aërate the sludge which is returned to aërating tank, as the incoming sewage is thereby more rapidly oxidized. The use of an air sludge lift has therefore the advantage of re-aërating the sludge, which has a great avidity for oxygen. The settlement tanks should be of such a depth as to allow the settled sludge to be drawn off or lifted without producing cross currents or unduly disturbing the rest of the liquid in the tanks. Experience has proved that the hopper sides of the tanks should be steep enough to prevent an accumulation of sludge, which, if allowed to accumulate by lodgment on the sides, would become septic and spoil the effluent. For this reason flat-bottom tanks have been advocated with mechanical means for drawing off the precipitated sludge. Baffle plates should be provided in the settlement tanks to prevent any flocculent matter passing away with the effluent.

The sludge, by reason of the agitation and aëration to which the sewage has been subjected, is in a very finely divided state and free from colloidal matter, and contains about 95 per cent. of water after the free water has been drawn off. A typical sample of activated sludge contains—organic and volatile matter, 64.7 per cent.; mineral matter, 35.3 per cent.

Activated sludge is a fertilizer, and a typical sample will contain 4.6 per cent. of total nitrogen and 2.6 per cent. of phosphoric acid. At Worcester no efforts have as yet been made to convert it into marketable form. It has simply been allowed to dry, and farmers have used and appreciated the dried sludge. There is a wide field for experimental work in the conversion of sludge into an easily handled marketable form.

The amount of dried sludge which is estimated to be obtained from one million gallons of sewage is approximately one ton, containing 10 per cent. moisture. The dewatering of the sludge after it has left the settlement tank is a problem which requires to be faced if its manurial value is to be realized and placed as a set-off against the cost of treatment. Good results have been obtained by pressure machines and by centrifugal action. The centrifuge appears to open out the best possibilities. In Milwaukee a machine has been in operation reducing a sludge of 98½ per cent. moisture to 79 to 85 per cent., and which can then be further reduced by means of heat to 10 per cent. moisture. The utilization of the resulting dried and powdered sludge as a marketable fertilizer has yet to become a practical proposition. The possobilities are there, but they require to be economically developed. The activated sludge has a higher nitrogen and phosphoric acid content, and is more suitable for plant life than any other sewage sludge.

Partially dewatered sludge, if it be exposed to hot sun for a few hours, will sometimes give off an objectionable odor of sulphuretted hydrogen, but this will only last a short time and is the only offensive odor that is likely to occur in connection with a properly controlled activated sludge process. It is found that well-aërated sludge is free from objectionable odor if drawn off before peak flow begins, i.e., after the sludge has been aërated all night and before it gets mixed with large quantities of fresh sewage. Conditions in this country are seldom favorable for sufficiently long periods to enable sludge to become naturally dried, and if the problem of sludge disposal is to be overcome, it is to be feared, conditions must be provided for artificial drying under cover, without exposure to sun, wind or rain.

One of the most promising suggestions is to dispose of the sludge by means of irrigation and distributing the wet sludge through a system of pumping mains. The nitrogen contained in wet activated sludge is available for plant food in greater proportion than in air-dried sludge. The cost of pumping would be cheaper than the dewatering and drying the sludge.

The settlement of the sludge in the settlement tanks occurs very quickly, and the purified effluent is decanted into troughs which convey it to the effluent channel, whence it is discharged into the River Severn. The remarkable speed of settlement can easily be seen by taking a sample of the oxidized sewage in a test-tube. In a few seconds the top layer is quite clear and can be decanted off. In about half an hour it should be possible to measure about 20 per cent. of sludge which would contain about 90 per cent. to 95 per cent. of moisture.

In accordance with the agreement made when the experimental installation was constructed at Worcester, the effluent should be incapable of putrefaction and contain not more than four parts by weight of suspended matter in 100,000 parts. The Worcester sewage is a weak one, chiefly domestic, but containing a fair number of trade effluents, and the purification effected by the activated sludge process has been satisfactory.

The following are the results of analysis made in January of this year:

| | Screened sewage. | Sewage as it leaves the aerating tank. | Effluent |
|---|---|---|---|
| Solids in suspension | 8.6 | 76.4 | 1.4 |
| Solids in solution dried at 100°C | 160.0 | 144.0 | 150.0 |
| Chlorine | 84.1 | 85.3 | 85.3 |
| Free and saline ammonia | 3.0 | 3.7 | 2.4 |
| Albuminoid ammonia | .41 | 2.1 | .25 |
| Oxygen absorbed in four hours | 3.5 | 7.2 | 1.2 |
| Dissolved atmospheric oxygen absorbed in five days (Adeney's test) | — | 3.0 | 2.3 |

The high chlorine figure is a local characteristic due to the proximity of brine at Droitwich, which apparently finds its way into the surface water.

# Disintegration of Concrete in Alkali Soils

## A Summary of Results of Laboratory Studies Together with Details of the U. S. Bureau of Standards Field Investigations

By G. M. WILLIAMS, Professor of Civil Engineering, University of Saskatchewan, at the recent professional meeting of the Engineering Institute of Canada at Saskatoon.

This paper is intended to be a brief review and summary of the conclusions reached by investigators who have studied the deterioration of concrete by alkali salts in the United States during the past 15 or 20 years

As the use of concrete in the arid and semi-arid regions of the West became more extensive it was found that structures in many localities were quickly attacked and disintegrated, apparently by the salts in solution in soil water and numerous laboratory investigations were begun, first to determine whether disintegration might be correctly attributed to alkali and second to discover some means of preventing the action. Later, the investigation was carried into the field where concrete of known quality was subjected to exposure to alkali ground waters as well as action of the elements which cannot well be duplicated in the laboratory.

As a result of these, as well as similar investigations undertaken in other countries it has been definitely determined that such deterioration of good quality concrete as has been found in alkali soils can be attributed primarily to the action of alkali salts in solution.

The weathering and breaking down of rocks by long exposure to the elements has resulted in the formation of soil, and the salts of sodium, calcium and magnesium which were once among the constituents of the rocks are now found distributed throughtout the soil, usually in greatest quantities in the clay and shales. All ground waters carry in solution appreciable quantities of one or more of these salts, but it is usually in the arid regions of the West that concentrations are sufficiently high to result in such waters being classed as alkali waters. Water percolating through the soil dissolves a portion of the salts with which it comes in contact and by this means they are slowly carried away through natural drainage channels to the sea or later deposited on the surface of the ground by evaporation of the water. In the humid regions, years of heavy rainfall have resulted in the leaching of the greater portion of the soluble material from the soil, so that the ground water is now low in salt content. In the arid and semi-arid regions relatively small quantities of soluble salts have been removed except where by irrigation or other means large quantities of water have been available with good natural drainage conditions.

What is known as "white alkali" is usually a mixture of the sulphates and chlorides of sodium, calcium and magnesium, while "black alkali", so called because of its tendency to dissolve vegetation or organic matter and stain the surface of the soil a brown or black color, contains a large percentage of sodium carbonate together with smaller amounts of the white alkali. The white alkali is the most widely distributed type, and experience has shown that it is more injurious to concrete.

### The Effect of Alkali Solution on Concrete.

The possibility of disintegration of concrete by alkali salts in the ground water became markedly apparent with the great development of irrigation in the Western States. The continued use of large quantities of water for irrigation has resulted in a gradual rise in the water table or soil water level in many localities, bringing this alkaline water in contact with the foundations and other portions of concrete structures below the surface of the ground

This disintegration is generally first noted and is most marked, at and just above the ground line and will vary with soil water conditions. Where the alkali water level is constantly below the limits of soil capillarity, disintregration will usually be confined to that portion of the structure which is immersed for a large portion of the time, with perhaps some deterioration at the ground surface due to the occasional presence of surface water.

Disintegration at or near the surface is no doubt accelerated by frost action and alternate wetting and drying, but these effects are only contributory

The appearance of concrete affected by alkali salts varies with the quality of the concrete, the concentration of the solution, and duration and condition of exposure. With good quality concrete of low permeability, the first stage of the action is marked by the flaking or shelling off of the surface skin of neat cement or rich mortar, exposing sand grains and aggregate particles. As the action continues larger aggregate particles are exposed and the new surface has the appearance of being abraded with white deposits of salts apparent in the pores. In the last stage the material loses its indentity as concrete and appears to be a mixture of aggregate particles distributed throughout a white soft putty like lime paste. This change may be accompanied by a considerable increase in volume. If soil water conditions change so that the mass becomes dry soon after disintegration has been partially or fully completed, there will be an appreciable hardening but the strength regain is very slight as compared with that of the original concrete.

Disintegration of concrete of low permeability is essentially a surface action which gradually progresses into the mass. In some cases the outer skin appears to be immune to attack but it does not entirely prevent the penetration of alkali water, which in reacting with the inner portion causes swelling which shatters the surface skin. Rapidity of penetraton is dependent upon quality of concrete and concentration of salt in the water, but usually chipping away the affected portion will reveal concrete which is apparently unharmed.

A somewhat different and more rapid action occurs in the case of more permeable concrete or in mortar mixtures of the type commonly used in hand tamped drain tile and sewer pipe. The comparative ease of penetration of the alkali water through the wall exposes a large volume of cement to the action of the salts and a rapid swelling and increase of volume results, the whole mass finally breaking down to form the typical white putty like paste.

When deterioraton of concrete in alkali soils was first studied, the action was generally ascribed to the use of poor aggregates or improper methods of mixing and placing concrete and it was believed that disintegration was brought about merely by the crystallization of alkali salts in the pores of concrete. Since the salts in crystal form occupy a greater volume than in solution it was believed that mechanical forces exerted were sufficient to disrupt the mass. This being true disintegraton could be avoided by producing concrete of low permeability which would prevent appreciable quantities of salt from entering. Laboratory investigation has shown that disintegration is not due to disruptive forces exerted by salt in crystallizing, but rather to the chemical reaction between salts in solution and constituents of the cement. Disintegration is primarily due to chemical action and any disruption which may occur under certain conditions as the result of crystallization is secondary.

The constituents of the cement attacked by the salts are lime, silica and alumina. During the process of hardening of concrete calcium hydrate is formed and it is this material which is most readily attacked. The sulphates of sodium and magnesium in alkali waters react with the calcium hydrate to form calcium sulphate and sodium and magnesium hydrates. The part played in the process of disintegration by these newly formed compounds is not well understood and probably varies with the permeability of the concrete and quantity and movement of the alkali water, but the final effect cannot be disputed since the changes produced in the laboratory under controlled conditions have been verified by the inspection of good quality concrete exposed to somewhat similar conditions in the field.

### Results of Laboratory Investigations.

One of the first laboratory investigations made to study the action of alkali solutions on concrete was that of Burke and Pinkney at Montana State Agricultural College started as a result of the disintegration of concrete sewers at Great Falls, Mont. The following conclusions are outlined in their Bulletin No. 81:—

1 The disintegration of cement by alkali salts is principally due to the reaction between these salts and the calcium hydroxide necessarily present in set cement. As a result of these reactions relatively

insoluble new compounds are formed in the body of the cement structure.—these new compounds have greater weight and require greater space than the Ca (OH) replaced. New compounds force apart the particles of cement thus weakening or breaking the binding material.

2. A certain weakening, not a disruption of the cement, is due to the loss of a portion of the binding material, crystallized calcium hydroxide, which is merely dissolved and moved in solution.

3. In order for destructive action to become marked, the alkali solutions must percolate through the cement, or at least penetrate beyond the surface.

4. Any measures that hinder the penetration of the alkali solutions into the interior of the mass will delay the destructive action.

The results of a laboratory investigation are summarized by Steik in Bulletin No. 122, University of Wyoming Experiment Station, as follows:—

1. A solution of magnesium chloride had the greatest disintegrating effect due to the action of hydrochloric acid produced by the hydrolysis of the salt.

2. The presence of sodium carbonate in solutions of the other salts retards the disintegrating effect.

3. The ultimate cause of the disintegration of cement is by the alkalies forming compounds with the elements of the cement which subsequently are removed from the cement by solution.

### The Tests of the Bureau of Standards.

An extensive laboratory and field investigation of the action of the salts in sea water on cement was conducted by Bates, Phillips and Wig of the U.S. Bureau of Standards and reported in Technologic Paper No. 12. Since the salts used in their work are similar to those present in the ground waters of the arid regions, their conclusions are applicable to concretes exposed to alkali waters as well as sea water. Their exposure tests of various mortars and concrete were made in the sea at Atlantic City, N.J. where a laboratory was fitted up at the end of one of the piers. As a result of their laboratory investigation supplemented by exposure tests in sea water, they have drawn up the following conclusions:—

1. Portland cement, mortar or concrete, if porous can be disintegrated by mechanical means exerted by the crystallization of almost any salt in its pores, if a sufficient amount of it is permitted to accumulate and a rapid formation of crystal is brought about by drying. Porous stone, brick and other materials are disintegrated in the same manner.

2. In the presence of sea water and similar sulphate chloride solutions:—

(a). The most soluble element in the cement is the lime. If the lime of the cement is carbonized it is practically insoluble.

(b). The quantity of lime, alumina or silica present in the cement does not affect its solubility.

(c). The magnesium present in the cement is practically inert.

(d). The quantity of $SO_3$ present in the cement up to 1.75% does not affect its solubility.

The most extensive field investigation under way is that commenced in 1913 by the U.S. Bureau of Standards in co-operation with the drainage investigations of the U.S. Department of Agriculture, the Reclamation Service and the Portland Cement Association. The field work was originally outlined by an advisory committee representing the preceding agencies. The committee was enlarged in 1919 by the addition of representatives from The Engineering Institute of Canada and the American Concrete Pipe Association.

Owing to the ultimate necessity of draining much of the irrigated land in the West it was decided to study first the durability of cement drain tile of various types and mixtures. Later, in 1915 concrete blocks were cast and installed in seeped land at various points. The test specimens are located on irrigation projects of the Reclamation Service and in territory which was being studied by the Drainage Investigations Branch. The original programme provided for the manufacture of 16 varieties or types of cement drain tile, 8" in diameter and 12" long. To replace tile removed for test five additional types or series have since been provided at intervals. The tile of the original series were manufactured during the summer of 1913 at a good commercial cement tile plant at Armstrong, Iowa. Good practice was followed in the manufacture of these tiles and every precaution was taken to make as good and uniform tile as the proportions of materials used would permit.

The tile were arranged in working drains about 800 ft. long for convenience in removal for test.

### Effect of Alkali on Mass Concrete.

To determine the effect of alkali waters on mass concrete placed above and below the ground line a large number of concrete blocks were molded and installed in 1915 These blocks are 10" square and 30" long with two steel reinforcing rods, 2" from the face with a third rod forming a loop at the top for assistance in handling. One series "A" was moulded at Denver, Colo., a central point where an excellent quality of aggregate was available. These blocks were shipped to all projects. Another series "B" was moulded at each project using local aggregates and cement and after curing for 30 days was set in place exposed to alkali waters. Using the same materials a third group "C" series, were moulded in position in the alkali water at each project. Blocks were installed at Orman S.D., Garland, Wyo., Fort Shaw, Mont., Sunnyside, Wash., Fallon, Nev., Mesquite, N.Mex., Montrose, Colo., and Grand Junction, Colo.

Throughout the block work care was taken to produce the best possible quality of concrete. All materials were weighed to ensure accuracy and thoroughly mixed by shovels in batches sufficiently large for a single block. Sufficient mixing water was used to result in a plastic quaking concrete which handled and placed easily. The consistency was not fluid as is commonly used in reinforced concrete construction and probably slightly stiffer than could be used in some types of work. Owing to the different brands of cement in use on the various projects and variation in types and physical characteristics of aggregates, a wide variety of concretes were obtained all of which are linked up in such a manner that definate conclusions can be drawn for all through the results obtained with the Denver "A" series blocks.

The tile originally installed were so grouped that excavation of a continuous trench 32' long would allow the removal of a section consisting of two each of the 16 types. Field tests made in 1914, 1915, 1916 and 1919 consisted of the removal of one or more such sections, and crushing tests which were made near the drain by means of the portable hydraulic tile testing machine. Samples of tile were obtained and observations made as to the condition of each, such as apparent amount of moisture and white salts in the walls. Samples of soils and waters were obtained for chemical analysis.

Concrete blocks were inspected in 1916 after one year exposure and again in 1919. This consisted of visual inspection of each block above and below the ground line. Samples of soil waters were obtained for analysis.

### Summary of Results.

Space will not permit a detailed discussion of the results of inspections and tests but the results may be summarized as follows:—

The drain tile may be ground as to consistency of mixture during moulding and method of moulding as follows:—

Group (a). Plastic Mix-machine made. Series 8, 12 and 16 (portions) (1-4); 7 and (11 1-3); 13 (1-2½); 9 and 10 (1-1½); 19 and 20 (1-2½).

Group (b). Plastic Mix ; hand tamped. Series 1 (1-2½) ; 3, 4, 5 and 6 (1-2).

Group (c). Quaking Mix ; hand tamped. Series 2 (1-2½); 1/ (1-1½); and 18 (1-2).

Group (d). Fluid Mix ; hand tamped. Series 14 (1-3) and 15 (sand cement 1-3).

Considering Group (a), one or more tile of each of these series has been found to contain varying qualities of salts at one or more of the projects. Tile of the proportion 1 part cement to 4 parts sand, plastic consistency (series 8, 12 and 16), have been found in this condition in all drains where exposed to alkali waters,, and at five of the eight projects, swelling, cracking and partial disintegraton has occurred. Tile made of one part cement to 3 parts sand (series 7 and 11), plastic consistency, have been found in better condition than those of the leaner mix, although there have been cases of disintegration.

Tile of group (b) have been found to contain salts at all projects where exposed to alkali water. Some have been badly swollen and cracked. These tile show the inefficiency of hard tamping and the high permeability which is characteristic of dry consistencies. No beneficial effects have resulted from the addition of ferrous sulphate to the mixing water of the tile of series 6 or by a coating of neat cement grout, or the tar coating of series 5, although the latter has acted as a retarder where concentrations were low. Tar seemed to have little beneficial effect in the higher concentrations.

The tile of wetter consistencies in groups (c) and (d) have generally shown themselves to be superior to (a) and (b). Series 19 and 20, 1915 replacement tile have shown themselves to be as resistent as the (c) and (d) groups. These two series were made on a machine of the tamper type which apparently produces a tile of lower permeability. Of the two latter groups, series 15 have been found badly affected in several of the drains· These tile are not fully comparable since the cement content is only one half that of a normal 1-3 mix. Series 17 and 18 both high in cement content and of quaking consistency have been found affected in the drains at Montrose, Colo. and Roswell, N.Mex.

These tile have a very low permeability and the disintegration is typical of the action on the best quality concrete, beginning just within the outer surface and progressing into the wall. Series 2 and 14 have been the most resistent of all tile used. Tile of Series 14 were found affected at Montrose, Colo. and Grand Junction, Colo., in 1916. Until 1919 none of the series 2 had shown the effects of alkali, but at this time a number were removed from the upper end of the drain at Montrose, lying in shale, and several were found to be damaged on the ends. No doubt these particular tile were exposed to much higher concentrations of seepage water which found entry to the of analysis of the water sample from the outlet of the drain at this point than was apparent from the result of analysis of the water sample from the outlet of the drain.

In summarizing the condition of the drain tile it may be said that rich mixtures of quaking consistency have proven to be most resistant to disintegration but that even the best mixtures as represented by series 2, 14, 17 and 18 may be affected under certain conditions, probably most dependent upon concentration of salts in the seepage water.

The condition of the concrete blocks after four years exposure to alkali waters is best measured and expressed by the salt concentrations which have been found in the different localities. At Fallon, Nev. where concentrations have been low all concrete is apparently unaffected. At Orman, S.D. where concentrations have been high practically all blocks except 1-1½-3 proportion Denver blocks have shown signs of disintegration . At Mespuite, N.Mex. where concentrations have also been high all blocks are badly disintegrated and cracked. In general the Denver blocks are in better condition than blocks molded on the projects. At three projects blocks molded in metal lined, planed wood and rough wood forms were installed for comparison. Results indicate no choice among these three surfaces. The "B" and "C" series blocks permit a comparison to be made between concrete cured 30 days before exposure with blocks which are molded in place in the soil and water. There is little choice, but the "C" series molded in place are generally in a better condition. Blocks exposed to the intermediate concentrations as at Garlad, Wyo. do not show marked signs of disintegration, but the effect of the alkali is evidenced by the shelling and scaling off of surfaces, at an above the water line, especially on the 1-2½-5 mixtures. Blocks made of natural cement and installed at Grand Junction. Colo. were completly disintegrated during the first winter's exposure. Freezing. and thawing no doubt accelerated this action.

### Conclusions

Consideration of the number of laboratory studies which have been made and the extent of the field work which has included all qualities of concretes and mortars exposed to a wide variety of conditions would seem to justify certain conclusions as to the effect of soluble salts on concrete.

1. Laboratory studies agree that disintegration is primarily due to reaction between the salts in solution and certain constituents of the cement. Disintegration is first a chemical action which may under some

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conditions be accelerated by crystallization of the resulting products as well as by alternate wetting and drying and the action of the elements.

3. Concrete of the highest quality, based upon present standards, have been seriously affected in high concentrations of sulphate waters.

4. Concentrations of salts in soil water vary so greatly only short distances apart that our present knowledge of underground drainage conditions does not permit of definite conclusions being drawn as to maximum concentrations which may be encountered in any locality.

5. Since it has been conclusively demonstrated that concrete of the best quality may be disintegrated the first step of the investigation may be considered complete. The second step, the finding of some means of preventing disintegration of concrete by alkali salts, other than by drainage is dependent upon chemical research. Bituminous waterproof coatings and that class of materials have merit but can be used only under certain conditions. What is desired is a cementing material having all the good properties and advantages of our present Portland cement with the additional quality of immunity to the action of alkali salts.

# Relief of the Housing Shortage in Montreal

## New Company is Undertaking to Erect 1700 Homes by Special Financial Scheme

Every comparatively large city in Canada and the United States, has for some time past been facing the problem of ever increasing rents. After the Armistice, manufacturing in all lines doubled and in some instances quadrupled, with the result that commodities in general, not finding a ready market, were put into storage or otherwise held by the manufacturer. This, in turn, necessitated a downward revision in prices.

Apparently the only exception to this rule was the building of homes for the average man. In many parts of Canada and the United States building stopped entirely, with the natural consequence, based upon the law of supply and demand, that rentals increased so rapidly the average man found himself face to face with a condition he had no power to remedy. The housing shortage became so acute in the city of New York recently that an act was passed exempting all builders for a period of years from taxation and this idea, intended solely to promote the ercetion of homes, is being followed out in various other cities. This in itself indicates how serious the shortage really is and how drastic must be the measures to overcome it.

The housing shortage in Montreal is no better than other cities. It is, indeed, a serious question. To cope with the situation in that city the Mutual Home Corporation Limited was recently formed under federal charter. Prior to the organization of the Company, its plan of operation was discussed with many leading Montreal financial and business men and from all reports the company is making progress at a very gratifying rate. The company is operating on a rather unique basis and to indicate the scope of its work, the following is quoted from a circular prepared by the company:

In order to understand our purpose, it must be borne in mind that it was not only necessary to build a home for Mr. Average Man, but also to make it possible for him to pay for the home. Two or three years, when industrial conditions were at their height, Mr. Average Man found no difficulty in arranging his finances so that he could purchase a home. Things have materially changed, however, so that to-day when he is approached, he cannot purchase a home because his finances do not permit. What is more important, the present sellers of homes have not changed their selling plans to meet the average man's financial standing.

We have found the financial solution to this problem. We have, to a very great extent, reduced the cost of construction by building on a quantity basis and as nearly as can be estimated, our saving in this direction amounts to approximately twenty per cent. This saving in itself should not be underestimated, for quantity production is most assuredly the one way to reduce the cost of materials and labor.

The saving in material cost is obvious, for certainly no one will deny the fact that purchases of 1,000 bath tubs in the present market can be made much lower than if only one bath tub is purchased. Quite naturally this holds true with practically every commodity which goes into the construction of a home.

In the Mutual Home Corporation Limited we have undertaken to meet the present situation squarely. It is not our purpose to sell homes at an enormouus profit, or at a price based upon so-called present volumes. After allowing a reasonable margin of profit, the selling price of the home is based strictly upon quantity production costs and by doing this we are actually offering a home for $6,000., with a confirmed belief that the buyer couuld not individually purchase it under $7,200.

Experienced builders and contractors will immediately see the advantages and saving in labor when a construction program of this magnitude is carried out. For instance, the floor plan of our 1,700 homes will be almost identically alike. If a certain number of workmen are employed to build the same type of construction week in and week out for a period of two or three years their efficiency naturally increases and in this way labor cost is substantially reduced because of quantity production. What effect our building program will have on idle labor is also something to think about, because there is unquestionably a large amount of unemployment at the present time with no immediate relief in sight.

Our next problem revolves around finances, viz., how can we pay our contractor in cash and at the safe time allow a home to be purchased without capital. Briefly, this is our plan.—

A lot owner, who is prepared to pay a minimum of $10.00 a week for a period of 300 weeks is invited to join a unit consisting of a 100 members. In this way $3,000 is collected every three weeks or enough to build a house costing $6,000, the balance being carried as a first mortgage. Each house when completed is alloted to a member of the unit, who takes up a first mortgage for $3,000 bearing interest at the rate of 7% or under per annum, and this is the only interest the member has to pay, for on the deferred payment of $3,000 no interest whatever is charged. Should a member of the unit receive his home before the full $3,000 deferred payment is made a second mortgage, without interest, is placed for the amount still due on the deferred payment, in favor of the other members of the unit, so they are fully secured for all payments made in advance of getting their own homes.

Seventeen such units of one hundred members each are in process of formation, which means that our construction program calls for 1700 houses. Our selling campaign calls for the formation of one unit every three weeks. Consequently the only down payment necessary is $30,00, or in other words a three weeks minimum payment by the member. There is also the additional security to the paying members that all unit funds are held in trust by a responsible Trust Company, and in the event of a member's death during the period of his deferred payments, his heirs receive the house fully paid up with the exception of the first mortgage of $3,000. All members are encouraged to pay as much as possible, for in that case they not only help themselves, but assist the speeding up of construction and in that way help out members who can only afford to pay the minimum of $10.00 a week.

Of course, there are naturally many financial ramifications confronting a prospective home owner· Supposing he has $3,000. in cash. If he wishes to pay this entire amount covering deferred payments, he receives his house immediately and assumes a $3,000 mortgage. On the other hand, supposing he has $,3000 on hand and also a steady income. In this case can utilize his $3,000 to pay up the mortgage and pay $10.00 per week at no interest until his $3.000 deferred payment is completed. In both of the cases mentioned, he saves the 20% because of our quantity production· This saving in his cost is causing many prospective home owners to purchase a lot and in this way we are really benefiting the real estate situation in Montreal, which at the present time is stagnant.

In case of a member defaulting in his payments, a period of sixty days is allowed him to sell his interest before being forfeited to the other members of the unit. In special cases such as sickness, arrangements will be made to either carry the sick member or his money returned. Houses as they are built are alloted to members with the most money paid in, and should two members be tied, the member who first joined will be given the advantage.

We are reliably informed that there are upwards of 26,000 vacant building lots within a few miles of the city hall, and while many are held for speculation, a large percentage are being held by men who purchased to buld. It is to this class that our project appeals to mostly. It gives us a very definite prospect list to work on, for when a man owns his own lot to build, he invariably had a very specific reason or wish that his future home should be built on that spot· Consequently, we reduce selling resistance and expense to a minimum, because we build a man's house where he wants it instead of selling him a house and lot where he probably does not wish to live.

By a re-investment of our profits which, incidentally, are not paid to us untill the house is delivered, together with additional monies received over the minimum payments required,, we are enabled to guarantee ta the unit member his or her home within three years from the time said member signs the contract. This time will probably be shortened to two years if more favourable conditions exist·

A new company to be known as the Wingham Wire Company and capitalized at $250,000, has been organized and will be located at Hamilton. All kinds of wire products wire rope, cables, etc., will be manufactured.

CANADIAN CONTRACT RECORD
PUBLIC·WORKS·· TENDERS·
ADVANCE·INFORMATION·
AND·MUNICIPAL·PROGRESS

# 31 Years Ago

***Items from the issue of September 6th 1890***

Toronto, Ont.—The Toronto Electric Light Co. has submitted the following offer for lighting the city streets: Eigh hundred arc lamps for two years at 38 cents each per night.

Tenders for excavation, masonry, brickwork and cut stone required for the new building of the Bell Telephone Company to be erected on Temperance Street are as follows: Stroud, $15,020; Aldridge, $14,450; Wickett Bros., $16,167; Page, $16,400; Hardy & Moss, $17,050. . . .

Brandon, Man.—The contract for the new city hall and civic buildings has been awarded Major Stewart, of Ottawa, the figure being $38,869.

Montreal, P.Q.—Tenders for sewers on Amherst and Cathedral Streets have been accepted by the Roads Committee at $7.50 per lineal yard.

The Smead-Dowd system of heating and ventilating has been adopted by the authorities of McGill College, where extensive alterations are in progress.

Port Burwell, Ont.—The by-law to grant $35,000 to the Tillsonburg, Lake Erie & Pacific Railway was carried in the Bayham Township.

Amherst, N.S.—Messrs. Robb & Sons intend erecting immediately large foundry and machine shops.

Peterboro, Ont.—The Canadian Edison Co. have decided to erect extensive works here, estimated to cost $30,000.

Among the architects and engineers calling for tenders in this issue are to be found: Robert Ogilvie, 9½ Adelaide Street East, Toronto; R. Findlay, New York Life Bldg., Montreal; John Shaw, chairman Toronto Committee on Works; Wright & Son, 204 St. James Street, Montreal; James A. Ellis, Toronto Junction; John T. Stokes, York County Engineer.

Leading editorials: Waterproof Whitewash, Lien Law Precedent, To Strengthen Ropes and Fire-proofing Exterior Surfaces.

Among the many advertisers in this issue are to be found: B. Greening Wire Co.; A. B. Ormsby Co.; R. Dennis, of London; Toronto Pressed Brick & Terra Cotta Co.; Warden King & Son, Montreal; and the Toronto Radiator Mfg. Co.

St. Catharines gas system will not be begun until next spring owing to the fact that American pipe factories are exceedingly busy. It would be interesting to know why this pipe is not being manufactured in Canada.

A Toronto property owner awoke from sleep recently to find that the side of his house had fallen out as the result of an excavation next door.

Current prices: XXX shingles, $2.35; scantling and joists up to 14 ft., $14.00; oil, raw linseed, 70 cents per gallon; grey lime, per 2-bushel barrel, 40 cents; Queenston cement, per bbl., $1.50.

## The Engineering Index

The Engineering Index for 1920, just published by the American Society of Mechanical Engineers, 29 West 39th St., New York, contains this year some 600 pages and has nearly 14,000 items referring to articles in some 700 engineering and allied technical ,publications, a list of which, with exact title place of publication and frequency of issue,is also given.

This is the second volume of the Engineering Index to be issued by the American Society of Mechanical Engineers. The book is a continuation of a work started in 1884 when Prof. J. B. Johnson of Washington University, St. Louis, began to index regularly for the Journal of the Association of Engineering Societies, the articles appearing in the leading current periodicals at that time. The first volume was published in 1889. At a later date this Index was combined with a somewhat similar service being then rendered by the Engineering Magazine Company of New York, and in 1895 the second volume was published jointly. From that date until the close of 1918 the Engineering Index was published regularly, volumes 3 and 4 covering five years each and succeeding issues annually. The Engineering Index was acquired by the Society at the close of 1918, and their second issue is just off the press.

This Index is a regular feature of the Society's monthly publication "Mechanical Engineering." The alphabetical arrangement of articles incorporated in the 1919 volume has been found very satisfactory and is retained. Price $6.00.

## Mainly Constructional

**East and West—From Coast to Coast**

The third annual Western meeting of the Canadian Institute of Mining and Metallurgy will take place in Edmonton from September 14-16.

The British firm, Sir John Jackson, Limited, public works contractors, are winding up their several Canadian branches. This firm constructed the Organization Point breakwater in British Columbia.

The recent report of the Housing Commission of York Township, Ont., shows the small balance of $18,610 on hand. Loans were made on 128 houses and the total amount of money advanced on loans was $473,420.

The carpenters of Hamilton held their annual picnic at the East End Mountain Park recently. A keenly contested program of sports, including many novelty races and a tug-of-war, was the feature of the outing.

The International Nickel Company, at Sudbury, Ont., has released 400 of its staff and will also close the Port Colborne refinery and the Bayonne, N. J., refinery. General business depression and accumulation of stock are given as the reasons for the close down.

Tenders have been called for the Canadian National Exhibition Board's new Pure Food Building. Construction work on this building, it is anticipated, will be commenced shortly after the present fair is over and the building will be ready for next year. The cost will be within the $150,000 appropriation, it is expected.

Building permits to the approximate amount of $800,000 were issued during August by the York Township Building Department, York, Ont., covering about 350 buidings, mainly houses of the six and eight-roomed type, for private owners. According to William Dever, building inspector, the amount exceeded that of the previous month last year by over $250,000.

The city of London, Ont. is conducting an investigation of the spring water supply in and around the city. A number of experts have been engaged who will sink wells where water is struck. If the water available from this source is found to be not sufficient to supply the city's needs for several years to come, a new scheme for obtaining water from the lake will have to be worked out very soon.

It is claimed by Mr. H. H. Lincoln, under whose management the Home Builders' Exposition was held at Fort Garry, Winnipeg, last spring, that building has been given considerable impetus in that district as a direct result of the exposition. He states that the Fort Garry Building and Construction Company, one of the exhibitors, have been very busy all season and do not expect to be able to complete the contracts on hand this year.

### Personal

Mr. Alfred Dryland, county engineer of Middlesex County, England, was a visitor in Ottawa recently. He inspected several roads in the vicinity of the capital, but stated that our Canadian roads were not at all comparable with English roads.

### Obituary

Mr. Beverly R. Laird, chief engineer of the Robb Engineering Works, of Amherst, N. S., died recently in that city after a short illness.

Mr. W. J. Thomas, well known contractor and roofer of 55 Wright St., St. John, N. B., died suddenly at his home a few days ago. Deceased retired one evening in apparently the best of health, but was found dead in his bed the following morning.

Mr. Angus Sinclair, well known Toronto civil engineer and railway contractor, died at his home in that city recently. Deceased was born at Chatham, N. B., in 1849. From 1860 to 1875 he was on the engineering staff of the Intercolonial Railway Company, in the latter year joining the Canadian Pacific Railway, at Port Arthur, Ont. After three years in this latter position he went into business as a railway contractor and constructed several miles of road for the C. P. R. and C. N. R. railways in Ontario and the Maritime provinces.

### Trade Incorporations

Barabe, Ltd., with head office at Montreal, capital $20,000, to carry on a general contracting business.

La Carriere Bussiere, Limited, with head office at St. Sebastien, P. Q., capital $90,000, to produce and deal in quarry products.

Dominion Housing Company, Limited, with head office at Toronto, capital $400,000, to carry on the business of builders and dealers in building materials.

# CONSTRUCTIONAL ACTIVITY

## Period of August 31 to September 6, 1921

*Dominion Wide Service Exclusive to "Contract Record & Engineering Review"*

### Waterworks, Sewerage and Roadways

**Annaheim, Sask.**
Tenders will be called shortly for construction of drainage ditch costing $21,000 for Prov. Govt., Dept. of Highways, Regina.

**London, Ont.**
Tenders will be called shortly for siphon lines for sewer improvement for City. H. A. Brazier, Engr.

**Ottawa, Ont.**
Construction of asphalt pavement on Armstrong St. is planned by City Council. A. F. Macallum, Commr. of Works.

#### CONTRACTS AWARDED

**Dublin, Ont.**
General contract for construction of drainage system for Hibbart Twp. Council is awarded to Gaunt & Gaffney, care of Twp. Clerk, Jas. Jordon, Dublin, Ont.

**Duncan, B.C.**
General contract for paving costing $20,000 for Municipality of Duncan is awarded to Hodgson, King & Marble, 508 London Bldg., Vancouver.

**Kingsville, Ont.**
General contract for pressure filters costing $10,700 for Town Council is awarded to Norwood Engineering Co., Florence, Mass., U.S.A.

**Maidstone, Ont.**
Geo. J. Christie, Maidstone, has general contract for construction of drain for Municipal Council.

**Regina, Sask.**
Dept. of Highways, Prov. Govt., awarded general contract for construction of highway from Flaxcombe to north of Alsask, Sask., to J. A. Mahoney, Alsask.

A. H. McFarlane, Kelliher, Sask., has general contract for construction of highway from Lipton to Dysart, Sask., for Prov. Govt., Dept. of Highways.

**St Catharines, Ont.**
Austin Longley, 154 Geneva St., has general contract for construction of sewage disposal plant for city.

**Toronto, Ont.**
A. Cope & Son, Hamilton, Ont., have contract No. 145 for earth excavation for Prov. Govt., Dept. Pub. Highways.

**Wingham, Ont.**
General contract for concrete pavement for Town is awarded to W. C. Brennan Contracting Co., Melrose Ave., Hamilton, Ont.

### Railroads, Bridges and Wharves

**Fort William, Ont.**
Plans are prepared for construction of street railway extensions for City.

**Gaspe, Que.**
R. C. Desrochers, secy. Dept. Pub. Works, Dom. Govt., Ottawa, will receive tenders until Sept. 16th for reconstruction of wharf. Plans at offices of Dept., Ottawa, Dist. Engrs., Rimouski, Que.; Post Office Bldg., Quebec, Que.; Shaughnessy Bldg., Montreal, Que., and Post Office, Gaspe. Accepted cheque for 10 per cent. of tender required.

**North Vancouver, B.C.**
Plans are being prepared for bridge to cost $30,000 for Prov. Govt. and Municipalities of North and West Vancouver.

**St. John's, Que.**
Construction of subway at estimated cost of $33,095 is contemplated by City. A. Morris, clerk.

#### CONTRACTS AWARDED

**Crystal City, Man.**
Henry Cook, 362 Flora Ave., Winnipeg, has general contract for construction of two reinforced concrete bridges for Municipality of Louise.

**Stouffville, Ont.**
Geo. Chenery, Bowmanville, Ont., has general contract for construction of reinforced concrete beam bridge for Uxbridge Twp. Council.

**Toronto, Ont.**
Contracts for excavating and reinforced steel for addition to car barns at Danforth and Coxwell Aves., costing $235,000, for Toronto Transportation Cmsn., are awarded to Castellani Construction Co., Ltd., Excelsior Life Bldg., and Steel Co. of Canada, Ltd., Hamilton, Ont.

**Widdifield, Ont.**
W. J. Davis, Widdifield, is awarded general contract for construction of bridge for Prov. Govt., Dept. Pub. Works.

### Public Buildings, Churches and Schools

**Chandler, Que.**
School Bd. contemplate erection of school. W. Murphy, sec'y-treas.

**Delta, B.C.**
Erection of school is contemplated by School Bd. E. R. Ball, sec'y.

**East Kildonan, Man.**
Church is being erected for Ruthanian Catholic Greek Church, Montrose and Watt Sts.

**Hearst, Ont.**
Women's Mission Bd. of Presbyterian Church in Canada, Confederation Life Bldg., Toronto, will erect hospital. W. L. Somerville, architect, 1 Bloor St. E., Toronto

**Mont Laurier, Que.**
School Bd. of Robertson and Pope, Que., will erect school. J. R. Miller, secy.-treas., Mont Laurier.

**Normandin, Que.**
Erection of school is contemplated by School Bd. J. S. Theberge, secy.-treas.

**Point Grey, B.C.**
Electrical, plumbing and heating contracts for school costing $125,000 for Point Grey School Bd., are awarded to The Electric Shop, 12 Hastings St. E., Vancouver, Orr Bros., 1210 Granville St., Vancouver, and Barr & Anderson, 1060 Homer St., Vancouver.

**Ste. Anne de Bout de L'Ile, Que.**
Erection of school is planned by School Bd. L. J. Boileau, secy.-treas.

**St. Etienne des Gres, Que.**
School Bd. contemplate erection of school. Jos. Dupont, secy.-treas.

**St. Francois Xavier de Brompton, Que.**
School Bd. plan erection of school. Jos. Labbe, secy.-treas.

**St. John, N.B.**
R. C. Desrochers, Secy. Dept. Pub. Works, Dom. Govt., Ottawa, will receive tenders until Sept. 12th for repairs to bldgs. of quarantine station. Plans at office of Dept., Ottawa; Chief Arch., Dept., Ottawa; Dist. Res. Arch., St. John, N.B., and Inspector Dom. Bldgs., Halifax, N.S. Accepted cheque for 10 per cent. of tender required.

**St. Mathias de Cabano, Que.**
Erection of church is contemplated by Parish.

**Toronto, Ont.**
S. B. Coon & Son, architects, 4 St. Thomas St., is preparing plans for school to cost $120,000 for S.S. No. 26, York Twp.

Bellsize Ave. Presbyterian Church Congregation will erect Sunday school at cost of $16,000. Craig & Madill, architects, 707 Yonge St.

**Tramping Lake, Sask.**
Plans are being prepared for school for St. Lucia S.D., No. 2485.

**Tranquille, B.C.**
Dept. Pub. Works., Prov. Govt., Victoria, will receive tenders until Sept. 15th for erection of nurses' home costing $30,000. Plans with H. Whittaker, architect, Parliament Bldgs., Victoria.

**Waterloo, Que.**
Erection of school is contemplated by School Bd. R. R. Bacham, secy.-treas.

**Winnipeg, Man.**
Erection of church at cost of $10,000 is contemplated by Danish Lutherian Church Congregation, Wellington and Victor Sts. Rev. K. Damskov, 173 Gordon Ave.

#### CONTRACTS AWARDED

**Belleville, Ont.**
Concrete for heating, ventilating and plumbing for repairs to Ontario School for Deaf for Prov. Govt., Dept. Pub. Works, are placed with McKelvey & Birch, Ltd., 69 Brock St., Kingston, Ont.

**Brandon, Man.**
Additional contracts for surgical bldg. for Hospital Bd. are: Electrical, Star Elec. Co., Winnipeg; plastering, Harrington Bros., Regina; painting and glazing, Robinson Co., Ltd., Regina.

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## Is the Building Industry Reviving?

Construction activity in August according to figures published by MacLean Building Reports, Limited., shows a tremendous increase over July. Contracts to the value of $36,307,200 were awarded as compared with $17,741,400 in July, an crease of over 100%.

This is by far the largest monthly aggregate since August, 1914, and is contributed to by the different Provinces as follows:—

| | No. of Projects | Value |
|---|---|---|
| Ontario | 908 | $20,355,700 |
| Quebec | 382 | 4,933,800 |
| Manitoba | 174 | 6,907,600 |
| British Columbia | 210 | 1,320,800 |
| Nova Scotia | 42 | 892,000 |
| Saskatchewan | 70 | 703,300 |
| Alberta | 71 | 684,300 |
| New Brunswick | 23 | 477,700 |
| Prince Edward Island | 7 | 32,000 |
| Total for Domnion | 1886 | $36,307,200 |

In analyzing these figures the Canadian Building Review states that a careful analysis of the above figures, shows that work was started on new factories and industrial plants generally to the value of $7,935,900, whereas for the previous seven months of the current year the sum total of industrial work started amounted to only $4,430,000. In other words the work started in August on factories was nearly 100% more than the combined total for the preceding seven months. That this is an indication of better times cannot be disputed because industrial expansion in times like these is conservatively planned and carried out. In view of the fact that prices in all commodities have been failing for the past 12 months it would not be surprising if there were no industrial expansion whatever. The manufacture of Canada must have substantial reasons for embarking on a considerable building program. While these new buildings will all contribute towards keeping the building trades busy during the coming winter there is also the promise of work in the new factories which will play an important part in relieving the unployment situation.

It is gratifying to note that in spite of reports authorities are undertaking public works and utilities to an ever increasing extent. Contracts awarded for the first 8 months for work of this nature amount to $40.750.700 as compared with $29.900.300 for the first 8 months of 1920 and $20.016.200 for first 8 months of 1919 and $14.890,400 for the corresponding period of 1918. The work that is being undertaken is of course, that which was delayed. during the war and much remains yet to be done. It is safe to predict that more and more of this class of work will be undertaken as officials become confident that prices are due for any spectacular slump.

For the year to date work has been started on 10.482 houses costing $49,334,500, being an increase of 18 per cent, over 1920, when work was started in the first eight months costing $41,835,400. For 1919 the total was only $29,956,600 for the same period and $9,932,100 in 1918. With prices slightly lower and stationary, and the demand still acute, increased activity can be expected. In the large centres many houses on the main streets are being converted into stores and apartments and many large conteemplated undertakings involve the demolition of residential property at present occupied. Suburban districts are rapidly filling up and agents for subdivisions, in many cases outside the city limits, report good sales.

In spite of the fact that the building season is more than half over contemplated work reported during August was as follows.—

| | No. of Projects | Value |
|---|---|---|
| Ontario | 171 | $7,407,600 |
| Quebec | 259 | 3,463,200 |
| Western Provinces | 178 | 3,356,600 |
| Maritime Provinces | 34 | 805,500 |
| Total for Dominion | 642 | $15,032,900 |

It is more than likely that this new work will be started this fall as it is too early yet for advance information on the projects for 1922.

In last month's Review it was indicated that there were advantages in building now and the forecast was made that greater activity would occur during the second half of the year than in the first. It would appear that the return of confidence which we were hoping for had already taken place and that the good showing for August is the outcome of a feeling on the part of the building public that a further recession in material prices and labour costs is very improbable. In fact, it is the opinion of some architects that costs will be lower this fall than they are likely to be for the next three years.

## A Correction

In the article on pages 794 and 795, of the last issue of the Contract Record, descriptive of the Hospice du Sacre Coeur, at Sherbrooke, P. Q., it was stated that the brick was furnished by the Laprairie Brick Co. Ltd. This is an error and should read, the National Brick Company, of Laprairie, Ltd.

# Ten Million Dollar Power Plant to be Erected at Grand Falls, Man.

## Work is Under Way on the Development of 168,000 h.p. on the Winnipeg River—Completed in 1924—Will Stimulate Industry

Upon his recent visit to Winnipeg, Man., from the east, A.W. McLimont, vice president of the Winnipeg Electric Railway Co., announoed that satisfactory arrangements had been made for the financing of a new power development at Great Falls on the Winnipeg River, 63 miles from Winnipeg. Edward Anderson, K.C., counsel for the company, is now in the east completing legal formalities. When completed the plant will have a capacity of 168,000 h.p., and will cost in the neighborhood of $10,000,000. Work on the construction of the plant is already under way, about 200 men being employed there. As the work develops it is expected that from 1,000 to 2,500 men will be employed.

The huge undertaking will be carried out under the charter of the Manitoba Power Co., Ltd., which company is taking over the plant and assets of the Winnipeg River Power Co., Ltd. In the Manitoba Power Co., Ltd., Sir Augustus Nanton, as president, will be surrounded by a strong directorate. A.W. McLimont will be vice-president and the active management of construction and operation will be in his hands. Mr. McLimont's many years experience in managing public utility properties of all classes will be an important factor in the success of the undertaking. The most recent hydro electric development which he was connected with was the 110,000 h.p. plant built by the Georgia Power Co. F.H. Martin is designing engineer for the Great Falls plant, and L.J. Hirt, of New York, the consulting engineer.

### Finally Completed in 1922

The Great Falls plant will be constructed in six units of 28,000 h.p. each, and will be finally completed in 1924. In 1914 aad again in 1919 preliminary work in connection with this big project was started, but owing first to the war, and then to financial conditions, the work had to be suspended. It was resumed a short time ago, and to date the coffer dam has been built, the site unwatered, and bunk houses for the workmen, and shops, etc., built. Much of the rock excavation has already been done.

Discussing the question as to what disposition would be made of the immense quantity of power developed, Mr. McLimont stated that he has already organized an industrial research department, headed by experienced electrical engineers, whose duties will be to induce power-using industries to come to Winnipeg. Mr. McLimont expressed the conviction that many new industries would locate in

**WHAT THE NEW POWER DEVELOPMENT MEANS TO WINNIPEG AND MANITOBA.**

Employment of from 1,000 to 2,500 people.

Average monthly wage bill of $125,000.

Purchase locally of supplies and provisions for employees on works amounting to over $20,000 each month.

Purchases through local houses of equipment and tools totalling over $750,000.

Purchase of 160,000 barrels of cement from local plants.

Purchase of 2,000 tons of structural steel from local shops.

Purchase of 100,000 bricks from local yards.

Purchase of 2,000,000 ft. of lumber from local yards.

Erection of a terminal station in Winnipeg at cost of over $500,000.

Bringing to Winnipeg and vicinity new industries, when power is availiable, employing at least 2,000 men.

Assures future development of Winnipeg as thriving manufacturing city.

Guarantees to Winnipeg and vicinity an unfailing supply of cheap power.

A perspective of the power development at Grand Falls, work on wnich has been started.

Winnipeg and vicinity as soon as the power was available, and in this regard instanced what has been accomplished in Quebec. In 1919, he said, the Southern Canada Power Co., completed the first installation of a new hydro-development in Quebec, and since that time the industrial department of the company has located 15 large industries in the district served, the industries being the branches of large American manufacturers. Those 15 companies represent an investment, in plant and equipment, of over $7,500,000.

"The necessity for more sources of electrical energy than already exist in Winnipeg for industrial and commercial purposes" said Mr. McLimont, "is very apparent, and with this additional power available Winnipeg is bound to develop fast as a manufacturing city."

The Winnipeg Electric Railway Co. will be one of the principal customers of the Manitoba Power Co., Ltd., inasmuch as the former will purchase all power necessary for operating its property over and above the power afforded by its own installation at Pinawa. The capacity of the Pinawa plant has already been far exceeded, and the power which the traction company will purchase from the power company will be used not only for railway purposes, but also for industrial and commercial purposes, while it is planned to heat the street cars with electricity when the new plant at Great Falls is completed.

A. W. McLimont, vice-president, Manitoba Power Co.

The plans of the Manitoba Power Co., Ltd., include the erection, at a cost of over half a million dollars, of a terminal station in Winnipeg, though no announcement is made yet as to the site on which such station will be built.

The site of Great Falls is easily accessible. Already an affiliated company---the Winnipeg River Railway Co., ---has constructed and placed in operation a standard gauge railroad, 13½ miles long, from theC.P.R. tracks at Lac du Bonnett to the Falls. When the plant is completed it will represent a splendid engineering accomplishment. The dam to be erected will have a maximum height of 70 ft., and a total length of 3,000 ft., and will create a pond or storage reservoir of 1935 acres, providing a deep, wide and extensive body of wate reaching upstream a distance of five miles The sluiceway section of the dam will be 530 ft. long, and will have capacity to discharge the maximum flow of the river without danger of flooding the headworks.

Much thought and attention is being given to the planning of the campsite. The buildings already erected are of a temporary nature, but when the final plans of the whole project are complete, Great Falls will comprise a model townsite with modern utilities and splendid facilities for recreation of the inhabitantts.

# Factory of Canadian Libbey Owens Sheet Glass Co.

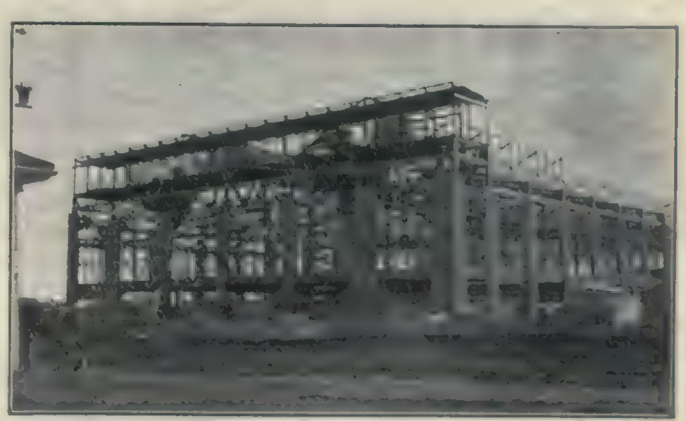
The new buildings and plant for the Canadian Libbey Owens Sheet Glass Company, at Hamilton is one of the most recent industrial developments and will be used for the manufacture of sheet glass. This will be the only place in Canada where plate glass is rolled.

The contract for the buidings was let in January of this year, and the plant is now ready for operation, being one of the most rapidly constructed set of buildings which has been built in Canada. The illustrations show the steel work of the furnace building, the Lehr buiding and part of the cutting rooms.

Furnace building and Lehr building and part of cutting rooms.

The construction of the building is of structural steel framework throughout, with brick piers and pilasters and steel sash. Long span trusses have been used to eliminate interior columns as far as possible.

The construction work proceeded continuously throughout the winter months and Mr. W.H. Cooper of Hamilton, Ont., was the contractor. The architects for the buiding were the De Vore Company of Toledo, and the structural steel was fabricated and erected by the Hamilton Bridge Company, Limited, Hamilton. Ontario.



Furnace building and Lehr building.

# Displays of Interest to Contractors at Canadian National Exhibition

**The Barrett Company,** of Toronto, had a large exhibit in the Manufacturers' Building, No. 2, in charge of Mr. J. F. Tobin, showing the company's entire range of building supply materials. A minature bungalow, school building and factory show off several of the products to good effect. Another feature was an automatically controlled stereomotograph, showing colored views of the application of Tarvia on several large highways in the Toronto district, also many recently constructed factories equipped with Barrett roofing. A miniature furnace demonstrating the application of the company's product "Nox-Aer-Leek", a cement for preventing the infiltration of air in brick boiler settings, was also an interesting feature. Among the other products displayed were: Elastigum "Carbosota" Creosote Oil, Everjet Elastic Paint, Everlastic Liquid Roofing Cement, Everlastic Multi Shingles, Liquid Elastigum, Velvet Shingle Creosote Stain, and a new type of flashing which is being used on the newLive Stock Arena being erected at the Exhibition at the present time.

**Messrs. Bird & Son,** of Hamilton, were situated in their "Neponset" bungalow, designed by W. Bredin Galbraith, Toronto architect, and erected two years ago. This bungalow presents a very pleasing appearance and was the subject of many commendatory remarks by its numerous visitors. Neponset Twin Shingles are used on the exterior walls and roof while Neponset Wallboard, with quartered oak finish lends considerably to the attractiveness of the interior. Other products shown were: Neponset Parcid roofing, Santite roofing, building papers, roofing paint and cement. Mr. Wakeford was in charge of the exhibit.

Rivalling in attractiveness and situated directly next door to the Bird & Son bungalow, was the **Brantford Roofing Company's** bungalow. This bungalow, roofed with the company's red asphalt slate roofing, was visited by large crowds and received many complimentary remarks on its attractive appearance. Small squares of red and green slate were given away as souvenirs.

**The Bishopric Manufacturing Company** and the **Canadian Roofing Manufacturing Company's** exhibits were combined in a very attractive little bungalow, in which the former company's Bishopric Stucco Board, a background for stucco finish, was used in the wall construction, while the latter company's Winthrop Tapered Asphalt Shingle was used for roofing. This latter product is a new addition to the Canadian Roofing Company's "Caramco" line. It is a shingle with a heavy butt tapering to a thin edge. The shingle is patented by this company.

The exhibit of the **Asbestos Manufacturing Company,** of Lachine, Que., was situated in their own neat and well designed bungalow, another popular and well patronized exhibit. The company were showing their many products, including asbestos pipe and boiler coverings, packings, etc., but featured "Asbestolate" the asbestos cement-tile roofing, "Linasbestos" fireproof wallboard, asbestos building lumber and asbestos corrugated sheathing. The many points of interest in these products were ably described by the company's Toronto representative, Mr. J. B. O. Kemp, who was in charge of the exhibit.

The feature of the **Waterous Engine Works** exhibit, was a recent model of their double cylinder road roller, under steam. Practical demonstrations of this modern machine in operation always had a large and interested audience.

The neat and artistic cottage housing the Ontario **Department of Puglic Highways'** exhibit was a popular spot for the many visitors interested in Ontario's good roads development scheme. The roadway in front of the building is constructed of short sections of the different road building materials used by the Department throughout the province. These sections are composed of concrete, bituminous concrete, brick, oiled top macadam, waterbound macadam and gravel. Representatives of the department were always on hand to provide any information desired and to hand out literature.

The large open air exhibit of **Wettlaufer Bros. Limited** of Toronto, was another popular spot with the many contractor-visitors at the Fair. A large number of willing represenatives were on hand to give practical demonstrations of and information concerning the several machines shown. Among the large line of machinery displayed were concrete mixers, brick and block machines, road building machinery of all types, electric and gasoline hoists and engines, rock crushers and screens, etc.

**The J. I. Case Threshing Machine Company,** of Toronto, were showing a 10-ton road roller for heavy duty road work at their open air exhibit.

The large exhibit of the **Sawyer-Massey Campany,** of Hamilton, though specializing in farm machinery, showed several pieces of contracting equipment. An item which attracted considerable attention was the complete portable crushing plant, operated by belt drive from a steam engine, and equipped with a bucket conveyor which carries the crushed rock to the 30-ton storage bin. The bin is divided into four sections for the different sizes of stone, which is graded by a revolving cylindrical screen. The crushing plant is low set, allowing for the easy feeding of rock. Other contracting machinery shown included a reversible road scarifier, double cylinder road roller, and a one-man, single-team road grader.

The pretty little two-room bungalow of the **Ontario Gypsum Company,** of Paris, Ont., situated convenient to the main thoroughfare, came in for its share of attention too. The company's products, interior and exterior gypsum board, were used in the wall consaruction and many were the comments on its neat, clean appearance, within and without. The product has been proven absolutely fireproof by actual tests on several occasions. Several interesting booklets were available, dealing with the above products, tlso "Gyproc" wall board, hard wall plaster and hydrated lime, handled by the company. Small sections of the gypsum wallboard were given away as souvenirs.

The **Rotary Brick-Machine Co**, of Toronto, showed their rotary brick press, a new machine in the brick industry, for which the company claim a daily production of over 56,000 brick per day. Several representatives were on hand to explain the working of the new machine to its many interested visitors.

The **Canadian Pozzolana Company,** of Toronto, showed their product, Pozzo, the Italian process stucco for exterior walls. This product, in addition to its exceedingly attractive appearance, is a fireproof material and the tent in which it was displayed was a centre of interest for many visitors.

The **Elliot Machinery Company,** of Belleville, manufacturers of wood working machinery, displayed their entire line of equipment in their large booth in Machinery Hall. The feature of the exhibit was the "Elliot" Woodworker, a complete woodworking plant, comprising saw, planer, etc.,

A large bucket-conveyor, of the type used in rock crushing plants, etc., equipped with Gibralter "Red-special" Belting, attracted considerable attention to the **Dunlop Rubber Company's** exhibit in Machinery Hall. The company showed their complete line of rubber goods.

**Peckover's Limited,** of Toronto, in addition to their several lines of structural and reinforcing steel, showed their "Kno-Burn" line of metal lath, for wall construction. Booklets outlining the reinforcing, fireproof and vermin-proof qualities of this metal lath were available, The exhibit occupied considerable space in Machinery Hall,

Practical applications of **Canadion Link-Belt Company's** chains, at their booth in Machinery Hall, added considerably to the interest of their exhibit,

Another exhibit in which considerable interest was taken by the many visitors to Machinery Hall was that of the **Prest-O-Lite Company of Canada,** at which they featured their oxy-acetylene process of welding.

**Baines & David,** of Toronto, occupied a large corner booth in Machinery Hall and every available bit of space was taken up by the extensive line of steel products on display. A few of the lines that came in for special attention were several types of reinforcing steel, steel sheets and rods, expanded metal lath, tool steel and cold drawn steel.

The feature attraction of the **International Business Machines Company,** in the Industrial Building was the company's latest model International time recorder, the last word in time recorder manufacture. Several representatives were on hand to explain the working of this machine.

A very extensive display of copper and brass ware was shown by the **Booth-Coulter Copper and Brass Company,** of Toronto, at their large booth in Machinery Hall.

Among the extensive line of products shown by the **International Nickel Company,** at their large booth in the Industrial Building, was the Monel Metal Screen manufactured by this company. Much interest was taken by the several visitors to this booth, in the sanitary, and rust-proof quaiities of this product.

The **Nichols Chemical Company,** of Montreal and Toronto, at their booth in the Industrial building, featured the "Hard-n-tyte" solution for concrete floor finish, a product of the General Chemical Company, of New York, for which the former company is Canadian agent. Samples of concrete floor in which the product was used were on dsplay and literature containing full information as to the application of "Hard-n-tyte were available to all interested. Increased wear resistance is only one of the qualities claimed for this solution.

The exhibit of **Shultz Bros Co Ltd.,** of Brantford, Ont., builders of "Brantford" sectional buildings, was an attractive, fully furnished, five-roomed bungalow and garage. These buildings were open for public inspection all day and thousands of visitors availed themselves of the opportunity of examining this class of home. The bungalow was very tastefully decorated and furnished.

An exhibit that held particular interest for the prospective builder was that of the **Canadian Self Locking Concrete Wall Company.** Mr. H. C. Hughes, construction superintendent of the company, superintended the erection of a structure of this type on the site of the exhibit, where the concrete slabs used in the work were cast. The visitors to this exhibit were struck with the simplicity of the construction work and deeply impressed by the advantages of the method from its economical, fireproof, heat and cold insulating and permanent features, as outlined by Mr. C. H. Ross, of the Winnipeg office, who was in charge of the exhibit. Several interesting photographs were also on display, showing this type of construction as used on several large buildings throughout the United States, some of which had stood the test of fire.

**Sturgeon's Limited,** at their attractive booth in the Industrial Buiding, featured their product, Solignum, wood preservatives and stain, in ten different shades. Other products shown included "Flintex" liquid hardener for concrete foors, and Paripan.

The exhibit of the **Cast Stone Block and Machine Company,** of Windsor featured this company's new product, the "Kewanee" All-Steel Coal Chute. A small section of wall constructed of the company's concrete block, was erected at the front of their exhibit, in which the coal chute was installed. This new device has many interesting features and drew considerable attention from the crowds at the Fair.

The **Granite Concrete Block Company,** of Weston Rd., Toronto, who shared accomodation with the Cast Stone Block & Machine Company, displayed a small section of residence wall, constructed of their concrete block. This type of construction has many good points, among which are, pleasing exterior appearance, waterproof and fireproof qualities and simple construction. This block was shown in different sizes of plain concrete and granite, rock faced and smooth faced.

The products of the **Consolidated Plate Glass Company of Canada, Ltd.,** were shown to good advantage behind a Zouri Safety Set Store Front, with plate glass windows, which formed the background of the booth, in the Industrial Building.

**The Buyers Door & Manufacturing Company of Canada,** at their large exhibit in the Industrial Building, displayed their complete line of doors, interior fittings, millwork and stair materials.

**The Laidlaw Lumber Company, of Toronto** were also situated in the Industrial Building, their exhibit being in a corner one and covering considerable space on two aisles. The highly polished hardwood floors and fittings of the booth gave it an air of distinctiveness and showed the products to excellent advantage. Doors, finished and unfinished, severtl types of hardwood floorings, cedar chests and other products of wood were shown. An interesting colored booklet containing plans and illustrations of a moderate priced home were handed out to all visitors.

The varied and extensive line of products turned out by the **Imperial Oil Ltd.,** were on display in their own building, where they have ample room for the showing of everything, with accomodation for many visitors to spare. This was a busy spot during the whole two weeks of the Fair. Among the products shown were samples of the company's different road building materials, sheet, asphalt, asphatic concrete and black base concrete.

**The Toronto Asphalt Roofing Company's** line of asphalt roofings, on display at their exhibit on the grounds, presented a very attractive appearance and came in for a great deal of attention throughout the Fair from many prospective builders.

**Clay Products Agency** of Toronto, and **Shale Products, Limited,** of Inglewood, Ont., shared accomodation in a large tent on the grounds. A small section of wall, constructed of the latter company's "Inglewood" Rough Texture Brick, in different shades of Buff, was a big drawing card for this exhibit. Many favorable remarks were heard from the numerous visitors on the beauty of this product. On display in the tent were several lines of vitrified clay pipe, in different sizes, flue lining and chimney tops. Mr. H.R. Shook, of the Clay Products Agency was in charge of the exhibit.

The **Canadian General Concrete & Engineering Company,** a new company, showed the practical application of their concrete slab in floor, roof and wall construction, at their tent on the grounds. Much interest was taken in the possibilities of this type of construction.

Doors and windows equipped with metal weather strip were on display at the exhibit of the **Triplex Weather Strip Company,** in the Manufacturers' Building, No. 2. This is an all metal strip, obtainable in either zinc or spring copper bronze, rust-proof, which protects doors and windows from draught and dust. The company also dislpayed their line of Triplex Metal Screens, in which they use Monel Metal.

**F. W. Lawson Company, Limited,** of Tironto, distributors for the Metallic Window Screen Company, showed the latter company's line of Thalmetal screens at their booth in the Manufacturers' Building, No. 2. This is an adjustable screen for which many new features are claimed. Several representatives were on hand to explain the use and advantages of the screen, which was displayed in a window frame.

# Specifications for Slow Burning Office Buildings

At the annual meeting of the National Fire Protection Association, the Committee on Building Consruction, of which Ira H. Woolson is chairman, submitted a report containing proposed construction specifications for rendering the so-called "non-fire-proof" class of commercial building reasonably slow burning. A typical joisted brick office building was selected as the first example to be treated. The principal provisions for this type of construction are reprinted below.

### Dimensions.

The height from grade to roof line shall not exceed 55 ft nor more than 4 stories.

The area within enclosure of fire walls shall not exceed the following:—

| | Without Sprinklers | With Sprinklers (Increase of 66 2/3% |
|---|---|---|
| Fronting on one street .. | 5,000 sq. ft. | 8,333 sq. ft. |
| Two streets ............ | 6,000 sq. ft. | 10,000 sq. ft. |
| Three or more streets .. | 7,500 sq. ft. | 12,500 sq. ft. |

### Stresses and Type of Construction.

Allowable floor loads and wind stresses shall be such as to conform to the best engineering practice.

Allowable stresses, quality of all materials and workmanship shall conform to the best engineering practice.

Working unit stresses for structural timbers used in dry locations shall be those given in the current specifications of the United States Forestry Service, and the net cross sections of timbers and not the nominal section shall be considered. In other cases where timber dimensions are mentioned, commercial or nominal sizes are referred to.

All girders or floor beams shall preferably be single stick timbers, but if double stick timbers are used, they shall be properly bolted together and contact faces shall be treated to prevent decay.

All work, whether construction or fireproofing, shall be installed under the supervision of a competent and reliable inspector.

All ceilings and all partitions (except intra-office partitions, for which there are no requirements) shall be constructed as hereinafter specified. There shall be no combustible lathing. Wood studs or joists shall not be over 16 in. center to center.

Highly silicious gravel as a coarse aggregate for reinforced concrete fireproofing shall not be used in portions of the building liable to be subjected to fire.

Wherever fire tests are referred to they shall conform to the Standard Test Specification of National Fire Protection Association.

### Foundation Walls.

For 1-story buildings, hollow building blocks of cement or clay may be used.

Foundation walls shall be built of hard burned clay brick or cement brick or stone, laid in cement mortar, or of concrete.

### Bearing Walls.

All bearing walls shall be built of hard brick meeting the requirements of the standard specifications for brick, properly laid and bonded, or of reinforced concrete or of other materials and construction meeting the 2-hour fire test requirements.

Veneered walls shall not be permitted unless the veneering materials are of equal fire resistance to the bearing wall and properly bonded, or tied thereto with non-corrodible metal wall ties.

### Exterior Walls.

All exterior walls shall extend not less than 3 ft. above the roof as a parapet, shall be the full minimum thickness and be properly coped, except that walls facing streets exceeding 40 ft. in width may omit the parapet. In such case, provision shall be made to guard firemen from walking off the edge of the roof.

### Non-Bearing Exterior Walls.

Such walls carried on protected metal or reinforced concrete members may be of brick, stone, hollow tile or block. Veneering may be included in the required thickness of non-bearing walls, supported by such structural members.

### Party and Fire Walls.

All such walls shall be built of brick, meeting the requirements of the standard specifications for hard or medium brick of the A. S. T. M., properly laid or bonded, or of reinforced concrete or other materials and construction meeting the 3-hour fire test.

All party and fire walls shall be continuous from the foundation to 3 ft. above the roof, and shall be the full minimum thickness and shall be properly coped.

Where wooden beams enter walls on opposite sides, there shall be at least 6 in. of brickwork between the ends or sides of these beams, and in no case shall they enter the walls more than is required for sufficient support of the beams.

### Thickness of Walls.

All walls should have a minimum thickness of 8 in. if of reinforced concrete, 16 in. if of rubble stone, or 12 in. if of other material.

Bearing walls shall be increased in thickness in such proportion as may be required for greater bearing area of stability.

Ducts, chases or flues not exceeding 1 ft. in width and not deeper than 25 per cent of the minimum required thickness of a wall will be permitted, provided they are not nearer together than 4 ft., nor within 4 ft. of any wall opening.

### Allowable Openings in Walls.

The maximum percentage of openings allowed in any exterior wall above the first story shall not exceed 40 per cent of its superficial area per story.

There shall be not less than 4 ft. of wall between openings in a vertical line.

Exterior window openings above the first story shall not exceed 50 sq. ft. in area, and no single dimension shall exceed 10 ft.

No window opening shall be less than 1 ft. from the ceiling surface, but the wall construction between the window opening and by the ceiling may, if desired, be replaced by a fixed fire window.

Openings in fire walls shall not exceed 48 ft. in area and the horizontal distance between adjacent openings shall be not less than 9 ft.

### Allowable Loads on Walls.

The allowable loads on walls shall not exceed the following in net tons per square foot:

| | |
|---|---|
| Brickwork laid in lime mortar | 8 tons |
| Brickwork laid in cement lime mortar | 12 tons |
| Brickwork laid in Portland cement mortar | 15 tons |
| Rubble stonework laid in Portland cement mortar | 10 tons |

The permissible working stresses on hollow tile or concrete block when laid in Portland cement mortar, with cells either vertical or horizontal, shall not exceed one-tenth the average ultimate compressive strength of the tile or blocks based upon gross area as shown by tests approved by the authorities having jurisdiction.

The unsupported height of a brick, hollow tile, or concrete block wall shall not exceed 15 times the thickness unless adequately reinforced.

All walls shall be securely anchored or boned at points where they meet.

### Piers and Columns.

Piers shall be built of hard burned clay brick or cement brick or stone laid in cement mortar, or of concrete.

If bonds are used in brick piers, they shall consist of perforated, rolled steel plates.

If cap-stones are used, they shall be protected against fire by 4 in. of fireproofing.

If a pier exceeds in height seven times its least dimension, it shall comply with the best practice in column designing.

All columns and bearing partitions shall be of such construction as will meet the requirements of the 2-hour fire test. All column protection shall make close connection with the floors at the top and bottom, and shall be so constructed as to leave no structural part of the column unprotected within the hollow space of the floor.

Columns shall be superimposed throughout all stories on approved column connection supports. Wood bolsters may be used to support roof girders only.

No pipes, ducts or wires shall be placed within the area of the required fire protection of columns or beams.

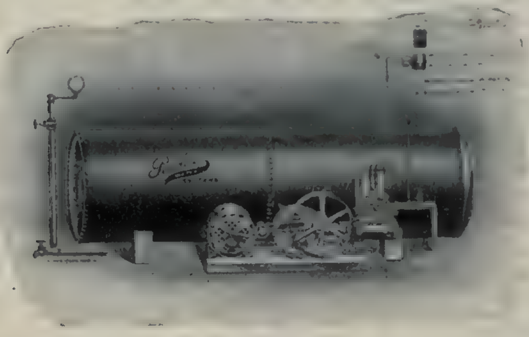
Where columns are used in the first story to support exterior walls, metal ties shall be provided to prevent them from displacement if the floor is consumed.

The plaster at joining of partitions and ceiling shall, when required, be reinforced with metal lath 4 in. on each surface to avoid any tendency to open cracks if settlement occurs.

Bearing partitions and others extending into floors shall be fire-stopped by completely filling the hollow spaces between joists and between studs to a height of 3 in. above the floor level with loose incombustible material held in place by painted or galvanized sheet metal, metal lath or other material not easily disintegrated by water, so installed as to act as a rat-proofing. If open mesh material is used, there shall be a thin layer of plaster to hold the loose material.

## Pneumatic Tanks for New Golf Club

The St. Clair Golf and Country Club which is to be constructed at Walkerville, Ont., from the plans of Mr. Stanley Thompson, of the firm of Lewis-Thompson Company, of Toronto, is to be supplied with water from equipment built by the National Equipment



Peerless tank and pumping unit.

will be found in the course of a few weeks at the Lookout Country Club, at Welland. The pump is located in a small house beside a spring which is 250 ft. below the tanks which are located in the basement of the main building. Water for the greens is taken from the main pipe line through reducing valves as otherwise the pressure would, owing to the unusual head of water be excessive.

Two 3,000 gallon "Peerless" tanks and a 4,000 gallon per hour pump completely automatic, will successfully handle the requirements of both club and course. Mr. Norman A. Kearns, 43 Temple Building, Toronto, is the architect.
rically driven 8,000 gallon per hour pump will automatically maintain a constant level and pressure in the tanks without attention.

Another interesting installation of pneumatic tanks Company, 55 Wabash Avenue, Toronto.

Two "Peerless" Canadian-built pneumatic tanks of 5,000 gallons capacity will supply the club and golf course with water at desirable pressures. An elect-

## Asbestos Industry Shown in Picture

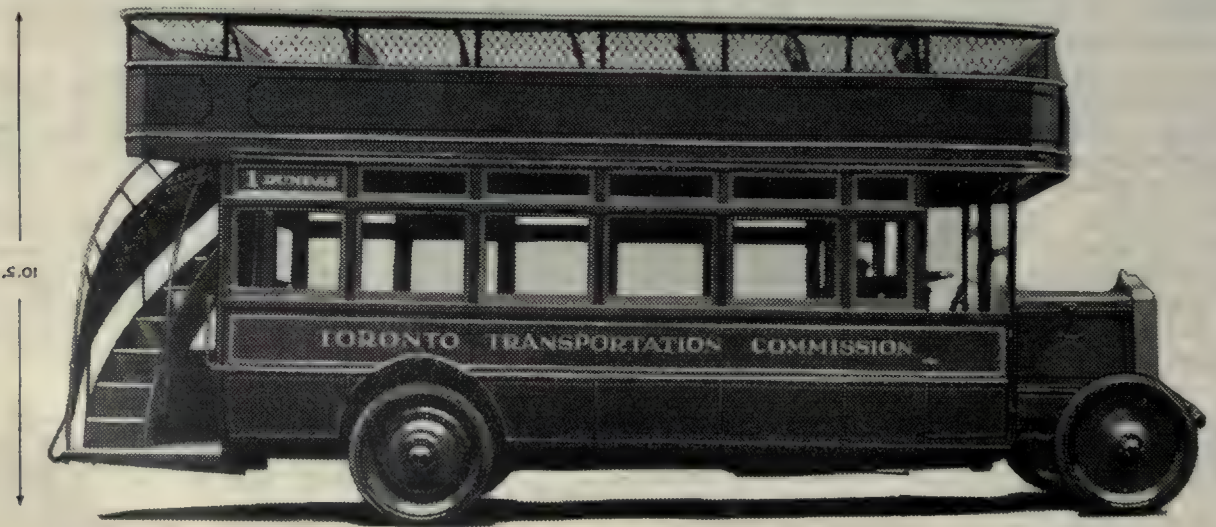
The Bureau of Mines, Washington, D. C., has recently completed a motion picture film showing the asbestos mines of the Johns-Manville Company and the various factories and processes in the mining, refining and manufacture of asbestos into its numerous products, such as roofings, insulations, packings, brake linings, asbestos textiles, papers and asbestos wools and other products. The picture is in four reels and runs a little less than an hour; available for presentation by clubs, engineering societies, Y.M.C.A.'s, etc.

## Toronto to Have 'Buses

Four buses like that shown in the illustration have been ordered by the Toronto Transportation Commision from the Fifth Avenue Coach Company of New York. The bus has a seating capacity of 48 people 22 insides and 26 on the upper deck. Arrangement for heating in the winter time are included.

This is the latest type low-level bus which makes it particularly well adapted to Toronto Conditions. It is only 12 feet from the ground to the top of a derby hat worn by a 6 foot man seated on the top deck. This means that the bus can be used under any of our Toronto viaducts with safety.

The rear platform is only one step above the ground which makes for quick loading and unloading and reduces the chances of accident to the minimun.



# Construction Developments During Month of August

## Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded—Analysis of Contemplated Construction

### *Comparative Statement of Contracts Awarded in Canada*

| | Ontario | Quebec | Maritime | Western | Total |
|---|---|---|---|---|---|
| August, 1921 | $20,355,700 | $ 4,933,800 | $ 1,401,700 | $ 9,616,000 | $ 36,307,200 |
| August, 1920 | 9,878,600 | 4,797,000 | 1,771,100 | 7,028,100 | 23,474,800 |
| August, 1919 | 10,696,700 | 5,796,800 | 1,795,300 | 3,731,800 | 22,020,600 |
| August, 1918 | 5,374,600 | 2,339,200 | 5,702,700 | 3,982,500 | 17,399,000 |
| 8 months, 1921 | $76,028,200 | 42,799,700 | 6,160,700 | 40,823,500 | 165,812,100 |
| 8 months, 1920 | 83,925,600 | 40,850,700 | 15,646,300 | 52,047,600 | 192,470,200 |
| 8 months, 1919 | 57,266,400 | 34,195,000 | 11,488,600 | 18,946,400 | 121,753,500 |
| 8 months, 1918 | 22,935,900 | 18,936,800 | 19,982,600 | 12,154,800 | 74,310,200 |

| | Residential | Business | Industrial | Engineering | Total |
|---|---|---|---|---|---|
| August, 1921 | $5,872,300 | $10,049,000 | $ 7,935,900 | $12,450,000 | $36,307,200 |
| August, 1920 | 4,195,000 | 8,008,500 | 7,399,500 | 3,871,800 | 23,474,800 |
| August, 1919 | 5,741,300 | 7,556,000 | 6,295,400 | 2,427,900 | 22,020,600 |
| August, 1918 | 1,816,300 | 3,196,800 | 3,696,500 | 8,689,400 | 17,399,000 |
| 8 months, 1921 | $49,534,500 | 63,361,000 | 12,365,900 | 40,750,700 | 165,812,100 |
| 8 months, 1920 | 41,835,400 | 68,054,900 | 52,679,600 | 29,900,300 | 192,470,200 |
| 8 months, 1919 | 29,956,600 | 37,943,000 | 33,837,700 | 20,016,200 | 121,753,500 |
| 8 months, 1918 | 9,932,100 | 17,463,600 | 32,024,100 | 14,890,400 | 74,310,200 |

### CONTRACTS AWARDED ACCORDING TO CLASSIFICATIONS, JANUARY TO AUGUST (INCLUSIVE), 1921

| | Ontario | | Quebec | | Maritime | | Western | |
|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value |
| Residential Buildings | [illegible] | $29,497,900 | 1740 | $ 9,731,800 | 325 | $1,428,700 | 2081 | $ 8,517,400 |
| Business Buildings | 900 | 25,014,000 | 485 | 23,457,800 | 110 | 2,661,800 | 715 | 12,227,400 |
| Industrial Buildings | 68 | 3,827,700 | 49 | 2,206,000 | 1 | 123,000 | 33 | 6,209,200 |
| Public Works and Utilities | 318 | 17,688,600 | 172 | 7,404,100 | [illegible] | 1,788,500 | 192 | 13,382,200 |

### *Details of Contracts Awarded During August*

| | Ontario | | Quebec | | New Brunswick | | Nova Scotia | | P.E. Island | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 3 | $ 27,000 | 4 | $ 57,000 | .... | .......... | .... | .......... | .... | .......... |
| Churches | .... | .......... | 6 | 374,000 | .... | .......... | 1 | $ 30,000 | .... | .......... |
| Factories | 8 | 2,191,000 | 3 | 120,000 | .... | .......... | .... | .......... | .... | .......... |
| Public Garages | 9 | 96,000 | 5 | 55,500 | 3 | $ 10,000 | .... | .......... | .... | .......... |
| Hospitals | 2 | 2,610,000 | 4 | 400,000 | .... | .......... | .... | .......... | .... | .......... |
| Hotels and Clubs | 3 | 227,000 | 1 | 5,000 | .... | .......... | .... | .......... | .... | .......... |
| Office Buildings | 12 | 168,500 | 5 | 46,000 | 1 | 5,000 | .... | .......... | .... | .......... |
| Public Buildings | 5 | 71,800 | 5 | 183,300 | .... | .......... | 1 | 12,000 | .... | .......... |
| Residences | 762 | 3,177,800 | 287 | 1,093,300 | 9 | 35,700 | 24 | 91,000 | 7 | $ 32,000 |
| Schools | 16 | 1,888,000 | 6 | 282,700 | 3 | 320,000 | 1 | 175,000 | .... | .......... |
| Stores | 35 | 328,500 | 9 | 163,500 | 1 | 25,000 | 2 | 19,000 | .... | .......... |
| Theatres | .... | .......... | .... | .......... | .... | .......... | .... | .......... | .... | .......... |
| Warehouses | 6 | 430,000 | 2 | 16,000 | 2 | 17,000 | 2 | 182,000 | .... | .......... |
| Total Buildings | 861 | $11,215,600 | 337 | $2,796,000 | 20 | $ 412,700 | 31 | $ 509,000 | 7 | $ 32,000 |
| Bridges | 8 | $ 181,000 | 9 | $ 270,300 | .... | .......... | .... | .......... | .... | .......... |
| Dams and Wharves | .... | .......... | .... | .......... | 1 | $ 5,000 | 2 | $ 25,000 | .... | .......... |
| Sewers & Watermains | 15 | 542,100 | 6 | 100,000 | 2 | 60,000 | 1 | 8,000 | .... | .......... |
| Roads and Streets | 22 | 287,000 | 27 | 1,063,600 | .... | .......... | 8 | 350,000 | .... | .......... |
| General Engineering | 2 | 8,130,000 | 3 | 703,600 | .... | .......... | .... | .......... | .... | .......... |
| Grand Total | 908 | $20,355,700 | 382 | $4,933,800 | 23 | $ 477,700 | 42 | $ 892,000 | 7 | $ 32,000 |

| | British Columbia | | Alberta | | Saskatchewan | | Manitoba | | Dominion | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 2 | $ 12,000 | .... | .......... | .... | .......... | .... | .......... | 9 | $ 96,000 |
| Churches | 1 | 3,000 | 3 | $ 27,500 | 1 | $ 12,500 | 2 | $ 6,000 | 14 | 453,000 |
| Factories | 7 | 39,100 | 1 | 39,800 | 1 | 11,000 | 4 | 5,535,000 | 24 | 7,935,900 |
| Public Garages | 5 | 39,500 | 3 | 10,000 | 3 | 13,000 | 3 | 32,000 | 31 | 256,000 |
| Hospitals | 1 | 12,500 | 2 | 120,000 | .... | .......... | .... | .......... | 9 | 3,142,500 |
| Hotels and Clubs | 2 | 12,000 | 3 | 21,200 | .... | .......... | 1 | 12,000 | 10 | 277,200 |
| Office Buildings | 3 | 28,800 | .... | .......... | 5 | 33,400 | 1 | 30,000 | 27 | 311,700 |
| Public Buildings | 2 | 11,500 | 2 | 40,000 | 2 | 29,800 | .... | .......... | 17 | 548,400 |
| Residences | 139 | 592,400 | 41 | 95,700 | 26 | 124,500 | 128 | 533,900 | 1423 | 5,776,300 |
| Schools | 22 | 314,400 | 11 | 123,400 | 15 | 132,000 | 7 | 306,700 | 81 | 3,542,200 |
| Stores | 14 | 74,800 | 2 | 32,000 | 3 | 17,000 | 8 | 35,400 | 74 | 695,200 |

| | British Columbia | | Alberta | | Saskatchewan | | Manitoba | | Dominion | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theatres | 1 | 20,000 | .... | .......... | .... | .......... | 2 | 17,800 | 3 | 37,800 |
| Warehouses | 2 | 70,000 | 1 | 10,000 | 1 | 35,000 | 2 | 225,000 | 18 | 985,000 |
| Total Buildings | 201 | $1,230,000 | 69 | $ 519,600 | 57 | $ 408,200 | 158 | $6,733,800 | 1740 | $23,857,200 |
| Bridges | 1 | $ 1,300 | .... | .......... | 1 | $ 5,600 | 7 | $ 45,200 | 26 | $ 503,400 |
| Dams and Wharves | 5 | 73,500 | .... | .......... | .... | .......... | .... | .......... | 8 | 103,500 |
| Sewers & Watermains | 2 | 4,000 | .... | .......... | 1 | 5,000 | 2 | 14,600 | 29 | 733,700 |
| Roads and Streets | 1 | 12,000 | 1 | $ 30,000 | 11 | 284,500 | 7 | 114,000 | 77 | 2,141,100 |
| General Engineering | .... | .......... | 1 | 134,700 | .... | .......... | .... | .......... | 6 | 8,968,300 |
| Grand Total | 210 | $1,320,800 | 71 | $ 684,300 | 70 | $ 703,300 | 174 | $6,907,600 | 1886 | $36,307,200 |

## *Contemplated New Construction Work in Canada for August*

| | Ontario | | Quebec | | Maritime | | Western | | Dominion | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | .... | .......... | 6 | $ 250,000 | 1 | $ 45,000 | 1 | $ 8,000 | 8 | $ 303,000 |
| Churches | 5 | $ 188,000 | 1 | 12,000 | 2 | 30,000 | 5 | 66,000 | 13 | 296,000 |
| Factories | 7 | 2,305,000 | .... | .......... | 2 | 65,000 | 5 | 553,000 | 14 | 2,923,000 |
| Public Garages | 3 | 63,000 | 2 | 28,000 | .... | .......... | 4 | 42,100 | 9 | 133,100 |
| Hospitals | 1 | 30,000 | .... | .......... | 2 | 45,000 | 1 | 40,000 | 4 | 115,000 |
| Hotels and Clubs | 4 | 158,000 | 1 | 10,000 | 1 | 250,000 | 7 | 247,000 | 13 | 665,000 |
| Office Buildings | 1 | 200,000 | 7 | 826,000 | 2 | 55,000 | 3 | 210,000 | 13 | 1,291,000 |
| Public Buildings | .... | .......... | 4 | 191,000 | 1 | 5,000 | 4 | 130,000 | 9 | 326,000 |
| Residences | 65 | 433,000 | 202 | 927,700 | 13 | 66,500 | 56 | 255,800 | 336 | 1,683,000 |
| Schools | 6 | 149,000 | 7 | 320,000 | 1 | 20,000 | 42 | 883,500 | 56 | 1,372,500 |
| Stores | 12 | 150,000 | 4 | 26,000 | 1 | 4,000 | 10 | 70,800 | 27 | 250,800 |
| Theatres | 1 | 10,000 | .... | .......... | .... | .......... | .... | .......... | 1 | 10,000 |
| Warehouses | 5 | 740,000 | 2 | 40,000 | .... | .......... | 1 | 5,000 | 8 | 785,000 |
| Total Buildings | 110 | $4,426,000 | 236 | $2,630,700 | 26 | $ 585,500 | 139 | $2,511,200 | 511 | $10,153,400 |
| Bridges | 17 | $ 511,500 | 4 | $ 125,000 | 2 | $ 30,000 | 9 | $ 80,500 | 32 | $ 747,000 |
| Dams and Wharves | 3 | 110,000 | 4 | 192,000 | 2 | 60,000 | 4 | 118,000 | 13 | 480,000 |
| Sewers & Watermains | 19 | 1,383,100 | 7 | 305,000 | 3 | 110,000 | 4 | 52,400 | 33 | 1,850,500 |
| Roads and Streets | 20 | 472,000 | 8 | 210,500 | 1 | 20,000 | 18 | 404,500 | 47 | 1,107,000 |
| General Engineering | 2 | 505,000 | .... | .......... | .... | .......... | 4 | 190,000 | 6 | 695,000 |
| Grand Total | 171 | $7,407,600 | 259 | $3,463,200 | 34 | $ 805,500 | 178 | $3,356,600 | 642 | $15,032,900 |

# Progress on Ontario's Provincial Highway Scheme

## An Outline of the Work that Has Been Accomplished to Date on a System of 1800 Miles of Interurban Highways —All Parts of Province Benefitting

Work which has already been completed on the Ontario provincial highways, which is now underway, or is promised before the end of the year, indicates that considerable progress has been made in the big 1,800 mile scheme. While an inspection of the routes shows that the roads are in various stages of repair or construction, it has been possible to make an analysis of the highway situation and show fairly closely what is being done in the province. Take the eastern half of Ontario first. Going north on the route from Toronto to Severn Bridge, the inspection tour shows two and a quarter miles of tar macadam pavement from Newmarket to Holland Landing, seven miles of macadam and earth grading being constructed north of Bradford, the balance of the distance into Allandale being gravelled from pits at the side of the road. From Barrie north, four miles are being graded, to be finished later with gravel and the balance of the road to Orillia is being patched, with gravel surfacing. From seven miles south of Orillia to the town it will be completely graded this year and partly gravelled, while the new entrance to Orillia, from the Hospital for the Insane to the town limit is included. From Orillia north four miles will be completed with macadam this year, which gives a macadam roadway through to Severn Bridge. The strip from Toronto to Newmarket is being put into a passable condition, while the travel strip is being widened in preparation for paving next year as announced by the minister of public works.

### Toronto to Quebec Boundary.

From Toronto to the Quebec boundary: Pickering Township will have three and a half miles of asphalt completed by the end of September, the balance of the township main highway being macadamized in preparation for paving. Macadam is going in west of Oshawa, and from Oshawa to Trenton the grading is practically completed, while a gravel surface is being maintained. From Port Hope to Peterboro a strip three miles south of Peterboro will be macadamized this year, while the bridge and culvert structures on the entire road will be practically finished, and the balance of the route will be good gravel. From Trenton to Belleville gravel road is being maintained; from Belleville east there will be a fine strip of macadam for six or seven miles. It is now being oiled. From Shannonville to Deseronto gravel road is being maintained; the same applies from Deseronto to Napanee, but the latter strip will be almost completely macadamized. Belleville to Picton is being brought to a gravel surface, and from Belleville north to Foxboro, structures and grading will be finished this year, with two miles of macadam, with the balance smooth-surfaced.

Napanee to Kingston will be practically unbroken macadam by the end of the year. Nine miles of macadam are going in east of Kingston, the balance to Gananoque will be maintained as macadam. From Gananoque east is being maintained to within three miles of Brockville; the rest will be tar penetration pavement this year. Brockville to Prescott to Johnstown has been finished with macadam; Johnstown to Manotick will be finished with gravel this year, with structures completed in three weeks. From Manotick north there are three miles of gravel, with balance of road to Ottawa good macadam. From Johnstown east to Morrisburg will be mostly macadam this year; east to Moulinette, in passable condition, maintained with gravel and stone; east to Cornwall, about three miles macadamized, with four or five miles of stone, being maintained, east to Lancaster, and from Lancaster to the Quebec border will be macadam by the end of the year.

From Ottawa east: Will finish three miles of asphalt linking up with three miles of macadam to Orleans; Orleans east will have eight or nine miles of asphalt penetration running to Rockland. Through Plantaganet and Alfred to L'Original, the balance is being maintained to the Quebec border at Point Fortune. There are some 200 culverts on this strip, which will be practically all completed this year.

Ottawa to Kingston route: Through Smith's Falls and Perth is being finished with tar macadam, with balance being graded, culverts going in, and maintaining with gravel and stone.

### West of Toronto.

Running west of Toronto, from York County boundary to Cooksville are four miles of asphalt on Dundas Street, with grading in Bloor Street from the city line to Dundas Street. Port Credit to Cooksvile, macadamized; Cooksville to Owen Sound, being maintained and graveled, with structures going in; Cooksville to Bronte Creek is being maintained; from Bronte to Clappison's Corners are nine and a half miles of macadam, with regrading on the Nelson Hill, while the three big Hamilton entrance bridges will be finished by the end of the year.

The grading of the Guelph road from Cooksville, with the approach down the Clappison Hill is being graded. From Clappison north are three miles of macadam; from Guelph south are three miles of concrete, with the balance being maintained as a gravel road.

Hamilton to Niagara Falls: Macadam constructed from Stony Creek to Winona; from Winona to Grimsby finished all but a half mile; from Grimsby to the Park Road macadamized; from the Park Road to Beamsviile being tar macadamized; finished from Beamsville to Jordan, and will be finished this year from Jordan to St. Catharines with macadam. From St. Catharines to Homer will be maintained; Homer to St. David's will be finished macadam with base course for pavement; from St. David's to Queenston and the Falls will be maintained.

From Niagara Falls to Welland, will build culverts and grade before freezing up; Dunnville to Cayuga, will finish macadamizing; Jarvis to Simcoe being maintained; Simcoe to St. Thomas being maintained as gravel, Talbot Road right through to Oldcastle being maintained as gravel, with culverts in; from Oldcastle to Windsor, three miles of concrete. From Hamilton south to Jarvis, three miles of macadam will be in with the structures completed over the balance.

Hamilton to Brantford: Will be concrete from Brant County line to Brantford; from Brant County line east, macadam base, within two and a half miles of Hamilton, and will be ready for paving next year Brantford to Paris, good gravel; Paris to Falkland, will complete grading this year; Falkland west to Woodstock, gravel and macadam sections; Woodstock through Ingersoll to Thamesforl, good gravel road gone in; from Thamesford west one and a half miles of asphalt, and from that point west to London is good gravel.

### London District.

Angling from London to Lambeth, four miles of concrete will be in this year, with the balance to St. Thomas maintained as a gravel road. From Lambeth to Chatham is being maintained as gravel road, the last two miles out of Chatham finished as concrete; from Chatham west to Tilbury, being maintained, will finish three quarters of a mile of concrete south from Tilbury, and from Tilbury west to Maidstone, the juncture with Talbot Road, is being maintained. Starting from Sarnia and running east are two and a half miles of concrete, while the balance through Parkhill and St. Mary's to Stratford is being graveled, with structures and grading completed. From London North to Elginfield is being graveled. From Stratford west towards Goderich are four miles of asphalt, with the balance getting its culverts, grading and gravel. Stratford to Kitchener being maintained and graveled; from Kitchener south three miles of grading are finished, and is being maintained through Preston and Galt; south of Galt is a finished macadam base course to Dundas Street, and from Dundas Street to Dundas town four miles of asphalt pavement are being finished. From Kitchener to Guelph, being graveled and maintained; Guelph to Chatsworth, brought up to good repair by grading, and the same applies over the stretch from Arthur to Kincardine.

## Trunk Road in British Columbia Nearing Completion

By the end of this month there will be nine miles of the Ladner trunk road paved towards the City of New Westminster, B. C. Last fall saw the commencement of this work when, under the Palmer Brothers' contract with the provincial government, a stretch of over one mile of concrete paving was laid adjacent to the A. D. Paterson ranch. In June this year the concrete work was again resumed and the highway is now concreted from the J. Chrystal farm, formerly a portion of the Kittson estate, for a distance of three miles.

A change in the government plans, owing to financial reasons, was then made, and it was decided to complete the remainder of the work on the hard surfacing basis; therefore a contract was let to the Columbia Bitulithic Company.

The stretch from the Ladner ferry landing to the Green road is fully surfaced and the Bitulithic Company expects to complete their contract by rocking and surfacing up to and three miles beyond, the already concreted portion of the road, as far as the crossing of the G. N. R. main line, by the end of September. When this is done there will be over six miles of bitulithic surfacing and about three miles of concrete paving on this trunk road for travel from Ladner to New Westminster and other points.

The paving under construction is 16 feet wide with 18-inch shoulders on each side, making 19-feet overall. There are three layers of asphalt, making a two-inch main surfacing on top of the rock foundation.

# Destruction of Concrete in Marine Structures

### Theories Explaining Disintegration at Above-Tide Levels—Possibility of New Designs

Since the introduction of reinforced concrete in the construction of piers, wharves, etc., the design generally adopted has been more or less on the lines of similar structures in timber, and it was until lately generally believed that these structures, apart from accidents, would be of a permanent nature. It has however, been forcibly brought to notice in structures of this sort that in many cases serious defects have been notice in portions of the structures situated above mean tide level.

The first indication of trouble is usually shown by a line of rust colouration on the surface running parallel and from 1 in. to 2 in. from the corners; these lines of colour gradually develop into cracks which enlarge until a coroner comes away, leaving the main reinforcement bar bare. This not only happens to the upper portion of the piles and the diagonal and horizontal bracing, but also to the deck beams which are well above high-water level.

It would be of great interest and value if those who are responsible for the maintenance of this kind of structure would give their experience as to whether they have had defects of this nature to deal with, and if so, how they occounted for them, in view of the fact that these defects do not appear to occur below mean tide level, or if so, ony to a very limited extent. It would also be of interest to discuss means of preventing similar defects in future structures, and also any useful means that could be adopted for treating those existing. If it is impossible to adopt satisfactory means of preventing these defects in structures designed on the present generally adopted lines, the question of adoptig a different form for, at any rate, that portion above mean tide level will have to be considered.

On this basis the following theories are presented. They are included in a paper presented by L. H. Saville at the Institution of Civil Engineers (British).

(1) At a certain level below high water, depending on the size of pile and range of tide, the concrete would be continously saturated with water and any small volume of oxygen dissolved in it, when once consumed by oxidation, would be difficult to replace, as it may be assumed that the water below the level of saturation remains continuously in the same region of concrete. Moreover, the water, probably become very slightly alkaine. This would then, account for the non-appearing of rust below the line of saturation.

(2) Above the line of saturation there would generally be a certain amount of moisture in the pores of the concrete. This would be partly in the form of liquid and partly in the form of vapour. As the temperature rises the liquid in the pores would tend to vapourise. At night, when the temperature fell, some of this vapour would condense, and in condensing a supply of air would be drawn in, giving the necessary oxygen for rust formation. If the pores in a circular pile are uniformly distributed and the daily range of temperature is 40 deg. F. the amplitude of the movement of every particle of air throughout the pile during the twenty-four hours would be about one-twenty-fifth of its distance from the centre, assuming that the air can expand. If the air is damp the movement would be increased in proportion to the vapour condensed.

(3) A theory which would account for rusting at high-water level could be constructed as follows:-

Steel is a good conductor of heat, concrete is a poor one. The temperature of the steel reinforcment near the water-line would correspond with the atmospheric temperature. At night when the air temperature falls the outer skin of concrete would contract but the steel would remain, for some distance above the water-line, at or near the temperature of the sea. This would tend to put the concrete above sea level in tension and the steel in unusual compression, and might at least in the long run destroy the bond of the steel and concrete, if not actually producing hair cracks in the concrete which would admit the necessary oxygen.

(4) When a load passes over a reinforced beam it is usual to assume that the steel takes all the tension. In any case, whether this is so or not, if the steel takes the greater portion of the tension it will extend and its cross-section will diminish, and this would tend to produce a vacuum which would draw in air. It is suggested that in this way, after repeated applications of loading, such as happens when railway trucks pass over beams, the bond to steel and concrete is broken and air may be drawn in.

(4) Experiments have been carried out to show that in a porous solid, such as an ordinary brick wall where a temperature gradient exists, gases will flow through the pores from the side at high temperature and escape on the side at low temperature. Whether the experiments quoted are reliable as to the quantity of gases passing is not known, but information on this point is very desirable, as if true, this would indicate the necessity of making impervious decks of reinforced concrete jetties which are exposed on the top to the sun.

(6) Information might be obtained from inspection of reinforced concrete beams, lintels, etc., carrying stationary loads, whether erected on the coast or inland, and a comparison of these with structures subjected to moving loads and of the same age could scarcely fail to be of use.

(7) Electrolysis may also be an active agent in producing deterioration, and information as to this would be of value.

# An Almost Unlimited Supply of Hydro-Electric Energy in Quebec Province

## A Limited Survey Indicates a Grand Total of Six to Seven Million Horsepower—Various Estimates Greatly Exceed this Amount—Only Small Fraction is Developed

By LEO G. DENIS
Engineer Commission of Conservation, Ottawa.

Canada's generously distributed water-power resources constitute one of her most valuable assets in the future industrial competition among nations. Water-power has always been a most important factor in the economic life of this country. It is estimated that, in 1901, the water-power utilized in the various industries of the Dominion amounted to 354,000 h.p., while a careful survey made in 1911 revealed a total development of 1,016,521 h.p. In 1915, this had been increased to more than 1,700,000 h.p., while recent figures show a total water-power installation of some 2,500,000 h.p. This rapid progress can be attributed, in a large measure, to the bountiful potential supply from which power can be drawn and it is of interest in this connection to form an idea of our latent possibilities. Unfortunately, it is impossible to give, for any country, an absolutely definite total regarding this natural resource, owing to the number of factors to be considered. Differences arise from allowances and facilities for artificial storage, from adaptability of industry to fluctuation in flow, as in certain electro-chemical processes which may be worked intermittently, thus adapting the demand for power to the flow available, also from the feasibility of using an auxiliary steam plant during the period of drought, if artificial storage is not practicable, and from many other causes which need not be specified in detail.

### Quebec Water-Power Administration

A recent estimate as to the water-power possibilities in Canada shows a total of nearly 20,000,000 h.p., divided between the different provinces as follows:

| Province | Estimated Possibilities |
|---|---|
| Quebec | *6,000,000 h.p. |
| Ontario | 5,800,000 h.p. |
| Manitoba | 3,218,000 h.p. |
| British Columbia | 3,000,000 h.p. |
| Saskatchewan | 567,000 h.p. |
| Alberta | 466,000 h.p. |
| New Brunswick | 300,000 h.p. |
| Nova Scotia | 100,000 h.p. |
| Prince Edward Island | 3,000 h.p. |
| Yukon | 100,000 h.p. |

If we now turn to the province which this article is intended to cover we find that the Government of Quebec has long recognized the importance of water-power in the development of that province. Since 1897 local water-power investigations have been carried on by the Department of Lands and Forests, and the work in connection with the water-powers of the province is now efficiently conducted under two separate organizations working in co-operation. The Hydraulic Service of the Department of Lands and Forests has charge of all questions relating to streams and lakes, including their administration and the leasing of water-powers, water lots and other water rights for various uses, while the authorization for the construction of dams and similar works is also dealt with by this Service. The Quebec Streams Commission devotes its attention more particularly to the construction of storage dams and the investigation of water resources. Conservation storage forms one of the most important branches of this Commission's work; its principal undertaking is on the St. Maurice river, where an immense storage reservoir, the largest in the world for power purposes, has been constructed. Other storage undertakings of the Commission include operations on the St. Francois and Ste. Anne de Beaupre rivers, while studies for future work include numerous other streams on which comprehensive water conservation is contemplated.

It may be added in this connection that in addition to the abounding water resources found in the province, the greatest asset promising much for future development lies in the far-sighted policy of the Government in water-power administration and the incentive and help given to hydraulic projects by the Quebec Streams Commission through its activities in water storage and other improvements.

St. Anne's Falls on the St. Anne River.

Much has been written on the water-power possibilities of Quebec province. Some four years ago Mr. A. Amos, Chief Engineer of the Hydraulic Service, gave a very comprehensive review of the hydraulic resources of the province in a booklet published by the Department of Lands and Forests. A recent paper read before the Engineering Institute of Canada by Mr. O. Lefebvre, Chief Engineer of the Quebec Streams Commission, also provides much valuable information in this connection. As previously noted, it is difficult to arrive at an accurate figure representing the

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* This figure represents known possibilities; estimates up to 15,000,000 have been made for this province, including New Quebec.

total possibilities of the province. A total of 6,000,000 h.p. has been estimated as the total for the known sites of the whole province, while Mr. Amos has estimated the power available in Quebec south of the 50th parallel at 5,000,000 h.p.

The manner in which the province disposes of its water-powers protects both public and private interest. If a water-power cannot develop more than 200 horse-power, the Government sells, for a fixed price, a lot in the river bed and the lots of land on the banks, if owning any, including the power than can be developed.

When the capacity exceeds 200 h.p., the concession generally takes the form of a lease. The terms of such leases are as uniform as possible and provide for a yearly charge; a portion of the payment covering rental for land is fixed, while the remainder is on a basis of 50 cents per h.p. Before development work can be started, the grantee has to submit plans of the proposed installation; he must begin work within two years and produce power within four, a deposit being required as a guarantee that the various conditions will be fulfilled. The leases vary in duration from 25 to 99 years, in accordance with the importance of the water-power and the amount of work required for its development.

### Montreal District, Rapids of the St. Lawrence

In Montreal district and in the thickly populated portion of the province, south of the St. Lawrence, undeveloped water-powers are still numerous. The Montreal district is generously supplied with hydro-electric power and. in this respect, its position is second only to that of the Niagara district. The principal source for future supply is the rapids of the St. Lawrence river, and in this connection the momentous project now being considered by the International Joint Commission is of particular interest. This involves a question which has attracted a very great amount of attention during the past two years in connection with the combined interests of power development and navigation. The two features of navigation and power production have been closely combined in connection with the scheme and while the former aspect is of much interest in transportation problems to many portions of Canada and the United States the development of power is of particular interest to the province of Quebec as the largest portion of the power involved lies wholly within this province.

The St. Lawrence as a primary source of hydro-electric energy has long been considered one of the most valuable assets of the world and the proportions of the undertaking have thus far retarded definite action or policy with regard to its exploitation. The power portion of the river from lake Ontario to Montreal involving some 2,000,000 horsepower or more has to be considered as a whole. Consequently, although the United States' share of the total available power is relatively small, the project assumes an international aspect and had, therefore, to be referred to the International Joint Commission. This body has been conducting an extensive series of hearings in connection with the proposed scheme at various centres in Canada and the United States covering both countries practically from the Rockies to the Atlantic. The physical or engineering problems have been referred by the Commission to an international board of engineers who are to shortly report on this phase of the undertaking.

### Portion of Province South of the St. Lawrence

If we now consider the portion of the province south of the St. Lawrence, the first tributary of importance below Montreal is the Richelieu, draining lake Champlain, but all the power on it is being fairly well utilized.

Next, the St. Francois river has attracted considerable attention of late, the Quebec Streams Commission having recently completed a very comprehensive storage regulation on it which has greatly increased the power possibilities of the river. In its total length of 120 miles between lake St. Francois and its mouth, it has a descent of 900 feet, while the river basin includes an area of nearly 4,000 square miles. The St. Francois river includes several important tributaries also affording numerous water-powers. The storage dam on lake St. Francois creates a storage capacity of 12.2 billion cubic feet, covering an area of 438 square miles and supplies 500 second-feet above the natural flow of the river, while lake Aylmer, whose outlet is also controlled by a dam, has been calculated to supply an additional flow of 150 second-feet. To give an idea of the effect of this on the power possibilities of the river, it may be said that if the total descent in the river could be utilized, 20,000 h.p. would be available on the St. Francois river alone through the use of this storage. The total water-power developed on the river before the storage was in operation amounted to over 32,000 h.p. Several of these developments did not operate to full capacity continuously but, with the new storage in operation, it is expected to almost completely remedy low-water conditions.

Montmorency Falls, Montmorency River, Quebec.

The West and East branches of the Nicolet and the Becancour river fall into the St. Lawrence, from the south, below the St. Francois. The West branch of the Nicolet and its tributaries have many small water-powers, while the Becancour river has an important undeveloped site at Maddington fall.

The Chaudiere, with a drainage area of 2,600 square miles, is important from a water-power viewpoint. A fairly large amount of power has already been developed on it while the Quebec Streams Commission has had a better regulation of its flow under serious study.

The possibilities of riviere du Sud are being partially utilized, while other rivers, including the St. Nicolas, Trois-Saumons, Ouelle and Kamouraska, are known to possess potential powers, but definite figures are not available.

The riviere du Loup, falling into the St. Lawrence over a beautiful cascade at Riviere-du-Loup, contains many water-powers. A total of over 3,500 h.p. is already utilized in the manufacture of pulp and in generating electric energy.

The Rimouski and Metis (or Mitis) rivers merit mention in connection with water-powers. The former develops 2,000 h.p. under a head of 52 feet for the manufacture of pulp, while the latter affords a site capable of developing 3,000 h.p. under a head of 115 feet.

The Madeleine is one of the most important rivers of Gaspe county. With its tributaries, it has a drainage area of 450 square miles, and is reported to offer many water-power possibilities, including sites at Grande chute, with a head of 200 feet and 10,000 h.p., and at Terrace rapids, twenty miles from the mouth, with a head of 283 feet and 10,000 h.p. capacity.

Among the principal rivers draining into Chaleur bay, the Bonaventure, Matapedia, Milnikek and Matalik have small water-powers in actual use, principally at lumber mills; these and other streams also possess power sites yet undeveloped.

### Quebec North of the St. Lawrence

On the north side of the St. Lawrence, the more thickly settled district above the city of Quebec is also well provided with water-powers, many of them in actual use.

The Ottawa river, debouching in several branches near Montreal, and, next to the St. Lawrence, the largest river of Eastern Canada, is rich in water-powers. Their value has been greatly augmented by storage operations in the upper waters although only a portion of the extensive project has thus far been completed.

The Ottawa, for the greater part of its course, forms the boundary between Quebec and Ontario, and its interprovincial powers are equally divided between the two provinces, while the storage activities are conducted by the Ottawa River Storage Branch of the Federal Department of Public Works. The three reservoirs now utilized have each an area of some 100 square miles and water is raised 15 feet on each, giving a total of 125 billion cubic feet or an additional flow of some 10,000 second-feet during the shortage period. The power possibilities under natural conditions reached the large total of 422,000 h.p.; with a regulated flow from these storage reservoirs and by taking the full advantage of descents at various sites this power could be doubled, as shown by the following estimate given in a recent report of the Ottawa River Storage Branch:— Quinze group, 170,000 h.p.; Timiskaming group, 120,000 h.p.; Mackey group, 170,000 h.p.; Pembroke group, 38,000 h.p.; Coulonge group, 94,000 h.p.; Portage du Fort group, 35,000 h.p.; Chats group, 100,000 h.p.; Ottawa group, 135,000 h.p.; Grenville group, 70,000 h.p.; Carrillon group, 135,000 h.p.; Riviere des Prairies group, 25,000 h.p.; total, 1,092,000 h.p.

The tributaries of the Ottawa on the Quebec side abound in power possibilities, and comparatively few of them have been utilized. There are, however, important developments on the North river, on the Rouge river and on the Lievre river. Numerous undeveloped powers also exist on these rivers, while the Gatineau, the largest tributary of the Ottawa, has over 20 known possible power sites, aggregating more than 200,000 h.p. at minimum flow. The High fall on the Lievre river may also be noted, where 32,000 h.p. is

Lord's Falls on the St. Francis River, at Drummondville.

Rapids in Grand Discharge, Saguenay River, Quebec

available under a head of 180 feet. The smaller tributaries, such as the Kipawa, North Nation, Cambria and others, also possess both utilized and latent powers.

Entering the St. Lawrence below Montreal is L'Assomption river, with its important tributaries, the Ouareau, Achigan, St. Esprit and Noire. The basin comprises fairly large latent water-powers, including sites of 2,000 h.p. and 3,000 h.p. capacity at Rawdon and St. Jean-de-Matha, but, thus far, only the smaller powers are utilized, the largest developing 450 h.p. The Maskinonge, du Loup (en haut) and Machiche rivers, all falling into lake St. Peter, and possessing only small developments, contain numerous possibilities, among which may be mentioned a site of 4,000 h.p. capacity on the Maskinonge at Ste. Ursule, and one of 2,000 h.p. on riviere du Loup at Magnan fall.

The St. Maurice river, the most important tributary of the St. Lawrence between Montreal and the Saguenay, has a drainage basin of 16,200 square miles. Apart from its size, the St. Maurice is conspicuous in many respects. At Shawinigan Falls it affords power for the largest concentration of developments in the province, and although other large water-powers on it have already been harnessed, many important sites still await development. The most interesting feature respecting this river is the storage undertaking of the Quebec Streams Commission in its upper waters. The principal reservoir is created by the Gouin dam at La Loutre, affording a capacity of 160 billion cubic feet, the largest power reservoir in the world, while it is only slightly exceeded by the Gatun reservoir, used in connection with the navigation of the Panama canal, which is reputed the largest known. When full, the area covered by La Loutre reservoir is over 300 square miles, the water being backed up 135 miles. It has vastly improved the water-power facilities of the river and is a decided benefit to the industries of that portion of the province. By the operation of this reservoir the minimum power available on the river has been doubled, increasing the low-water flow at Shawinigan from 6,000 second-feet to 12,000 second-feet. The most important rapids and falls have recently been enumerated in a paper by Mr. O. Lefebvre, Chief Engineer of the Quebec Streams Commission, as follows:— The Gres, 44 descent or head in feet; Shawinigan 135; Grand Mere, 40; La Tuque, 90; Blanc rapid, 210; Des Coeurs rapid, 93; Allard rapid, 55. The Shawinigan and Grand Mere sites are being fully utilized under respective heads of 150 feet and 75 feet, while a portion of La Tuque power is also in use.

In addition to the important water-powers on the St. Maurice itself, many sites are also found on its tributaries. Among these are the Shawinigan, Milieu, Bostonnais, Vermilion, Manouane and Ruban rivers, all affording possibilities at various sites ranging in capacity up to 1,500 h.p.

Another important tributary of the St. Lawrence, the Batiscan river, also affords numerous latent water-powers. A plant of some 2,000 h.p. capacity near St. Narcisse has been in operation for many years, while in the first 54 miles from its mouth, the Batiscan contains sites with heads varying from 10 feet to 69 feet and capable of developing a total of approximately 25,000 h.p. at the low-water stages.

In connection with the Quebec City district, which is generously supplied with energy from a number of hydro-electric plants, it is of interest to note another of the activities of the Quebec Streams Commission undertaken for the benefit of one of these plants. A storage dam has been constructed at the outlet of lake Brule on the Ste. Anne de Beaupre river to increase the power available at the St. Fereol plant, Seven Falls, where a head of 410 feet is utilized. It is expected to increase the minimum flow of the river from 165 second-feet to over 200 second-feet, while additional storage is also contemplated.

Between Quebec district and the Saguenay the only fairly large river on the north shore is the Malbaie, which enters the St. Lawrence at the well-known summer resort of the same name. It has a drainage area of 800 square miles and supplies two developments at Malbaie, while many other falls are known to exist on the river. By proper regulation on its many lakes, the minimum flow could be greatly increased.

The Saguenay, or Lake St. John, district is one of the most important in the province from a water-power viewpoint and its rapid development is due in a large measure to attractive industrial opportunities offered by this natural resource. The developments in actual use are quite numerous, but the latent powers of this district are even much greater than those which have already been harnessed. The

Saguenay itself offers a very attractive site as it debouches from lake St. John through the Grande-Decharge, and plans have been elaborated to utilize this power in connection with an important industry. Under a total head of 300 feet, divided into two steps, it would be possible to produce 300,000 continuous horse-power. This capacity could easily be increased to 600,000 h.p. by using lake St. John as a storage reservoir, a project in which the Provincial Government intends to co-operate.

Among the other rivers rich in water-powers and awaiting development may be mentioned the Ashwapmuchuan (or Chamouchouane), whose known possibilities total 160,000 h.p.; the Peribonka (or Peribonca) and Mistassini with 200,000 h.p. each; and the Metabetchuan, Shipshaw and Muskosibi, with between 10,000 h.p. and 30,000 h.p. each.

Hemming's Fall, on St. Francis River, Quebec—A typical Quebec scene.

The north shore, below the Saguenay, also contains large rivers offering attractive water-power possibilities. Some of the sites are already being utilized mainly for pulp and lumber mills, some of which are of fairly large capacity. The most important rivers known to possess latent water-powers are the Outardes, with 150,000 h.p.; the Bersimis (or Betsiamites), with 75,000 h.p.; the Manikuagan (or Manicouagan), with over 450,000 h.p.; and the Portneuf, Sault-au-Cochon, Manitou, St. Jean, Romaine, St. Augustin and Natashkwan, each with from 10,000 to 30,000 h.p.

The Grand fall, on the Hamilton river, has long been known for its power possibilities, and its development for the production of chemical fertilizer and other industries has been under consideration; the total descent, extending over twelve miles, is 760 feet, which, if fully developed, would produce 300,000 h.p., while another site on this river is estimated at 86,000 h.p.

### Hudson Bay Basin

On the large rivers flowing into James bay many attractive power possibilities are reported where these have been explored. The known water-powers on the Megiskan (or Megiscane) river aggregate over 10,000 h.p.; on the Bell river, 15,000 h.p.; on the Harricanaw (or Harricana), 175,000 h.p.; on the Nottaway, 300,000 h.p.; on the Rupert, 250,000 h.p.; and on the Eastmain, 340,000 h.p. While these are probably the largest in the region, there are numerous latent possibilities of a smaller order on rivers in closer proximity to the National Transcontinental railway and several sites have already been investigated on the Kinojevis, Kewagama and La Sarre rivers.

To sum up the water-power situation in Quebec, it may be said that, in the more thickly populated portions, hydraulic resources are playing a large part in industrial development. While their absorption has already created a demand greater than the supply in certain quarters, this deficiency is being remedied by the extensive conservation storage operations which have been initiated by the Provincial Government through the Quebec Streams Commission. In the more sparsely populated portions of the province, with few exceptions, water-powers of great magnitude still remain undeveloped. Although numerous sites are utilized in the pulp and lumber industries, great opportunities still remain for the use of latent powers in similar or other undertakings.

## Growth of the Lignite Industry

Mr. Leslie R. Thomson, secretary of the Lignite Utilization Board, recently read a paper on the lignite Bripuetting industry in Western Canada before the Society of Chemical Industry, at Montreal. He referred chiefly to the development of the gevernment plant at Bienfait, Sask., which will have a capacity of 100 tons of lignite briquuettes a day. This fuel will be obtainable at about $17.50 per ton, compared with $0.00 for coal, and is claimed to be superior to coal. The plant, he stated, was constructed by the Dominion, Saskatchewan and Manitoba governments at a cost of $680,000 the possibilities of this industry and as there are large supplies of lignite available in western Canada for commercial development, there is every reason to look forward to the rapid growth of the lignite briquetting industry.

# Mainly Constructional

**East and West—From Coast to Coast**

The McKinnon industries plant at Welland, Ont., has reopened after a short shutdown. Several hundred men are at work, which numbers are likely to be increased before long.

Hon. F. C. Biggs, Minister of Highways, Ontario, officiated at the opening of the Thamesville-Wabash road recently. This is a two and a half mile stretch and cost $75,000 to construct.

The Gary Motor Truck Co., Manufacturers, Gary, Indiana, U. S. A. have purchased a large plant in Toronto, Ontario, and will be manufacturing motor trucks, dump trucks and motor busses.

Messrs. E. Dussard & Co., of Montreal, have taken up new premises at 243 Plessis St., where a complete line of ceramic, porcelain and roofing tiles, Belgian and other foreign marbles, slates, etc., will be carried.

During August fifty-one building permits were issued at Kitchener, Ont., totalling $165,955 in value. This figure compares favourably with the previous months amount, $70,660, and also with that of August a year ago, $47,025.

Recent reports from the different building trades at Toronto indicate an improved condition in the unemployment situation, the amount of employment at the present time being the largest since the beginning of the year.

St. John, N. B., is another point to report a large increase in building figures for the past month of August in comparison with the same month a year ago. Last month's figure of $213,500 shows an increase of $191,300 over the August, 1920 total.

Mr. A. Dowker, formerly engaged in the manufacture of brick at McIrvine, Ont., is going into the rock crushing business at Fort Frances, Ont. He has rented the town's rock crushing plant, is erecting storage bins, etc., and shortly expects to have operations under way.

Headquarters of the Engineering Branch of the Department of Public Works in Western Canada has been moved from Winnipeg to Victoria. This change was considered advisable in view of the fact that a larger proportion of work is being carried out in British Columbia than in the Prairie provinces.

The Joint International Committee, which has been engaged preparing plans, etc., for the erection of a Peace Memorial Bridge over the Niagara River, announces that a complete statement of its work and findings will be ready for presentation to the United States and Canadian governments by October 1.

The total value of permits issued at Sarnia, Ont., during the month of August last was $69,155. Though this figure falls about $15,000 short of the figure for the previous month of July, it brings the total for the first eight months of the year to $1,137,192, or $394,927 over the figure for the same period of 1920.

After considerable delay, the Board of Works at Windsor, Ont., has finally located a site for the proposed new civic asphalt plant. Excavation for the foundation was commenced a few days ago and no time will be lost in getting construction work under way. The site is on the corner of Elsmere and Hanna Avenues.

Building figures for the first eight months of the present year, at Windsor, Ont., are slightly ahead of last year's figure for the same period, permits this year totalling $3,944,470 compared with $3,821,300 in 1920. Last month's figure of $207,900 was slightly under the figure for this month in 1920, however, which was $272,125.

Hon. T. W. Patterson, deceased lieutenant-governor of British Columbia, who died at Victoria recently, was a resident of Ontario for several years after his arrival in Canada from Scotland in 1870. In 1885 he became connected with the Canadian Pacific Railway Company, on construction work in Western Canada.

The Dominion Bureau of Statistics reports an increase in the production of pig iron and ferro-alloys during the month of July over the previous month, of 2,000 tons. Production of steel ingots dropped from 62,339 tons in June to 52,641 tons in July. A decline in the production of electric steel from 1,278 tons in June to 608 in July is also reported.

The demand for engineers with business training has led the Faculty of Applied Science of Queen's University, Kingston, Ont., in co-operation with the Departments of Economics and of Commerce and Administration in the Faculty of Arts, to establish a special course of a year's work in commerce for engineering graduates of any Canadian University. The subjects to be studied willl include general economics, business, finance and business law, economic geography, the financial organization of society, marketing, accounting, problems of labor, industrial management, business statistics, and business policy.

## Personal

Mr. R. Home Smith was recently chosen to succeed the late Mr. Lionel H. Clarke as chairman of the Toronto Harbor Commission.

Mr. A. W. Hanks recently resigned from the Dominion Bridge Co., at Winnipeg, where he was employed on the engineering staff, to accept an appointment with Mr. John A. Patterson, general contractor, of that city.

Mr. David W. Mill, for the past twelve years Assistant Superintendent and Inspector of Surveys, Crown Lands Department, Quebec, has been promoted to director, succeeding the late Mr. J. E. Girard. Mr. Mill is a vice-president of the Corporation of Professional Engineers of Quebec and also a member of the Engineering Institute of Canada.

D.O. Lewis recently resigned his position as assistant to the chief engineer, Canadian National Railways, at Toronto, to enter the firm of Engineering Corporation, Ltd., in British Columbia. Mr. Lewis has had many years experience in railroad work, being with the Canadian Pacific Railway Co. for seventeen years, and for several years with the Canadian Northern and Canadian National Railways. The Engineering Corporation, Limited, carrys on a consulting engineering practice on railway, hydro-electric, irrigation or other large engineering enterprises.

## Obituary

Mr. James Reid, contractor of Moncton, N. B., died recently at his home in that city. Deceased was born at Mount Thom, N. S., 79 years ago and had been engaged in the contracting business at Moncton for several ears. Many of the largest buildings in the city were erected by him, a few of these being, Royal Bank Building, Bank of Montreal, Canadian Bank of Commerce, Y. M. C. A. Building, and Brunswick Hotel.

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## *Canada's Stupendous Fire Loss*

Every man, woman and child in Canada suffers either direct or indirect financial loss because of the lack of control of our national fire loss. About $25,000,000. goes up in smoke every year; much of this is due to carelessness; almost all of it is preventable.

Think what this means—enough money in this one item to pay one-quarter of the interest of our national debt!

But this is only part of the story. There are also a large number of human lives lost annually and many more persons suffer bodily injury in varying degrees. There is the loss of production, and the delays all along the line incident to the dislocation of business at one point or another. For this reason the annual cost of this "luxury" that we insist upon having, is actually running to a much higher figure than the $25,000,000 mentioned above. If everything could be calculated—the actual loss in property value, delays, loss of human lives, the general dislocation of business, loss of customers and cost of reclaiming them, etc. etc.—it is probably not beyond the mark to say that our annual bonfires cost us one hundred million dollars—enough to carry our whole national debt.

There are two ways of improving these conditions. The first is by being careful ourselves; by teaching other people to be careful; by preaching safety and cauiton. The second method is to build in such a way that fire does not readily get a hold and make rapid headway before the firemen arrive. Neither of these can produce the best results alone—they must be complementary—they must be worked together.

With the object of impressing the necessity for caution on the public mind it is the custom to set aside a period that has come to be generally known as Fire Prevention Week. For local reasons, the United States has standardized on the week which includes October 9, and Canada has fallen in line so that the greatest good may result from the united efforts. This year, therefore, Fire Prevention Week will be October 9 to 15, inclusive.

Twenty-five million dollars is worth saving—so are the human lives that are lost with it every year. Every organization—boards of trade, clubs of various kinds, town and city councils, boards of education, engineering societies, contracting and building associations, boy and girl scouts—all can do a share of the necessary educational work. Only let us keep the two primary points in mind—first, construct our buildings so they will not burn; second, use every caution to prevent a fire starting.

## *The End of the Tunnel*

From the brilliant sunlight of super-prosperity we have plunged into the dark tunnel of re-adjustment.

It was a very black tunnel at first and all of us were a bit dazed, but who other than a fool would sit in the dark and cry out, "I'm blind."

A few of us were seized with panic and trampled madly about in the dark bumping our shins and injuring not only ourselves but others.

Some few of us fell and were killed. It was a trying time that first few months in the dark but gray streaks of light are penetrating the blackness. The faint stripes that mark the arrival of the tunnel's end.

It is a long, long tunnel and it will be some time yet before we emerge once more into the sunlight, but the end is in sight.

The pall of gloom is lifting like a summer fog.

All the ghosts, goblins and boggies that howled at us in the dark and sent the shivers up and down our spines have evaporated, proving the thinness of their construction.

Business is better. Doesn't it sound fine to be able to truthfully say that? Business is not 100 per cent right yet but **Business is Better.**

From the Asphalt Shield

## *Improvement in Bnsiness Conditions*

Still a further improvement in business conditions throughout Canada has been manifested during the past week, states a recent weekly trade report of the Canadian Credit Men's Trust Association.

Montreal and Quebec Province, Ontario and Maritime Provinces all report more activity in manufacturing circles reflected from increased orders being received by manufacturers. This is most pronounced in boots and shoes, dry goods, men's and women's wear and such lines. An encouraging feature also is the booking ahead by retailers, who are generally reporting favourably on conditions, although certain allowances must be made for the usual demand for seasonable goods.

In Winnipeg and Manitoba wholesalers find an im-

*No. 61*

# *Canada's Engineers — N. W. Warren*

Canada's later constructional history is interwoven so closely with that of The Dominion Bridge Company, Limited, that it is an especial pleasure to include in our series this week Mr. Norman Woodruff Warren, the new general manager of that well-known organization.

The post to which Mr. Warren has succeeded is one of the most important and interesting appointments of this kind in the country, for the Dominion Bridge Company, as everyone knows, stands in the front rank of the great engineering organizations of this continent and its name has been associated with undertakings which have attracted even world-wide attention.

Mr. Warren is in the prime of life. He is a graduate of Yale University— of the class of '99 S. Upon graduation he joined the staff of the American Bridge Company. He then went to the Berlin Construction Co., remaining with them nine years in the acquisition of varied and valuable experience in their several engineering departments. Coming to Canada in 1910, he identified himself at Montreal with the Structural Steel Company. Shortly afterwards he became assistant chief draughtsman—and later chief draughtsman of the National Bridge Company.

In 1913 the Dominion Bridge Company bought out the National Bridge Company, and Mr. Warren continued for a time as chief draughtsman. Two years later he was appointed manager of the interests still conducted under the name of the National Bridge Company. Upon the outbreak of war, in the memorable August of 1914, the National Bridge Company was closed down as a fabricating steel plant, and Mr. Warren was associated with the Dominion Bridge Company at Lachine for a short period,—but only for a few months, as in February, 1915, he was appointed acting western manager. A year later he was appointed western manager, with headquarters at Winnipeg, and he remained with the Dominion Bridge Company in that capacity until July of this year, when he was appointed general manager, with headquarters at Montreal.

While Mr. Warren will be received back into the engineering fold at Montreal with open arms, he leaves a place at Winnipeg which will not be easily filled. One recalls his name from many active and useful spheres in the western capital. He is an ex-chairman of the Prairie Province Branch of the Canadian Manufacturers' Association; was vice-president of the Winnipeg Builders' Exchange and was a member of the executive of the Winnipeg Board of Trade. The esteem in which he is held by these bodies found expression upon his departure from Winnipeg in the joint arrangement of a formal luncheon—attended by some two hundred business men—at which Mr. Warren was presented with a beautifully-engraved gold watch.

Outstanding among the responsible executive periods of Mr. Warren's life, the great strike at Winnipeg, with which the Dominion Bridge Company were intimately identified, is worthy of far more than the passing mention that can be given to it in a sketch of this nature.

Mr. N. W. Warren

Mr. Warren is devoted whole-heartedly to the advancement of engineering interests. In other fields at Winnipeg, he held membership in the Manitoba Club and in the Motor Country Club. The warm wishes of a host of western friends accompany him in the greater responsibilities of his new appointment.

provement in orders, more especially in dry goods, boots and shoes, underwear, musical instruments, etc.

Retail trade shows an improvement, particularly in dry goods, furniture, men's and woman's wear and light hardware.

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## B. C. Lumber Trade Directory

The Fourth Edition of the "A B C" British Columbia Trade Directory and Year Book has just come from the press and is replete, as usual, with every conceivable piece of information concering the lumber industry of the Pacific Coast. As the title of the publication indicates it is essentially a directory of lumber and shingle mills, manufacture of special lumber products, logging camps, lumber wholesalers, log brokers, timbers cruisers, towing companies and other interests affiliated or associated with the lumber trade. These lists have been brought right up to date. A digest of customs tariffs and timber laws of British Columbia is included, as well as a great deal of technical and statistical information, covering the forest products of the Pacific province. Another valuable feature of the publication is the buyers' guide which is a directory of mill supply houses. The book contains 184 pages and sells at $3.00, the publishers being The Progress Publishing Co. Ltd., London Building, Vancouver, B. C.

# "Le Foyer"—A New Home in Quebec

## Building Costing $130,000 to be Completed by December—Architectural Features and Construction Details

The Headquarters of L,Oeuvre de la Protection des Jeunes Filles, which have been located for many years past on Palace Hill, Quebec City, will soon be moved to the new building here illustrated.

The new home, where office and shop girls will find perfect protection combined with pleasant and comfortable living conditions, is situated in one of the best residential centres of old Quebec. It has a frontage on three streets, measuring 92 feet on St. Angele street, 103 feet on Dauphine street and 84 feet on Ste Ursule street where the main entrance is to be found. Plenty of light and air is provided as can be noticed by the number and size of the windows.

The new home was designed and built under the supervsion of Messrs Tanguay & Chenevert, architects, 20 d'Aiguillon street, Quebec. It is being erected at a cost of $130,000.00 by C. Emile Morissette, Ltd., who were awarded the general contract.

Old residences with thick walls of rubble masonry had to be demolished to clear the site and like everywhere else in the upper-town, foundations were excavated in solid rock, some 500 cubic yards of material having been blasted out and removed.

A construction view of "Le Foyer" in Quebec city.

The exterior will have a clean and sober appearance, cut stone from Deschambault being used in connection with shale brick supplied by the Citadel Brick & Paving Rock o., Ltd. All the masonry works are being executed by J. B. Jinchereau & Sons, of Quebec.

The floors and roof are supported on steel beams and columns, but no terra-cotta or cement coating is to be used as a fireproofing device. Pitch and gravel roofing, of the Barrett specification type, has been laid by Napoleon Barbeau.

Hot water heating combined with ventilation devices of the Woodman system, sanitary plumbing and electric lighting are being supplied by Jobin & Paquet, Rgd., while glazing and painting are being handled by La Cie Gauthier & Frere.

The interior will be of plain construction and finish; plastering is being supported on wooden laths and the flooring is to be of hardwood except in the bath rooms, lavatories and laundry, where tiles are to be used.

Work was started last April and the building will be completed by December next.

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## New Telescopic Portable Conveyor

### Device Now on the Market is Capable of Handling Material at Varying Distances up to 40 ft.

Portable conveyors, which have an ever increasing field of usefulness with contractors for taking out foundations, for roadmaking and grading, for handling overburden, etc., in mines, also for the efficient and cheap handling of coal, ashes, sand, gravel, crushed stone, etc., have had in the past a limitation to their usefulness, owing to the fact that there was no variation to the distance at which the material being moved could be deposited, except by having a number of individual conveyors of different lengths. This limitation has been entirely overcome by a new type of telescopic conveyor (fully covered by patents) which is now on the market.

For general use the telescopic conveyor is made in two standard sizes. Type "A," the smaller size, is eighteen feet long when closed and thirty feet when extended. Type "B," the larger size, is twenty feet when closed and forty feet when extended, giving, respectively, a range of twelve and fifteen feet over which material can be placed without moving the conveyor.

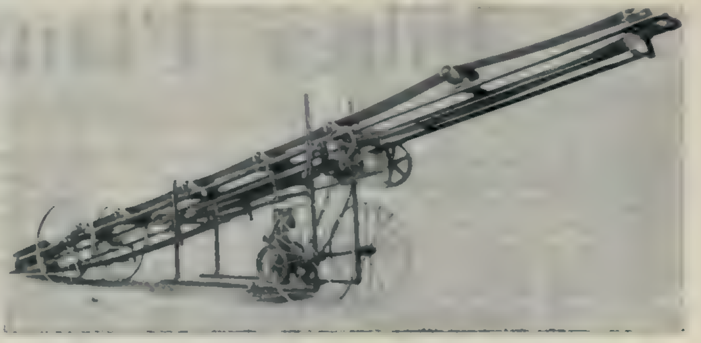

Fig. 1 – A telescopic conveyor delivering material to a distance of 40 feet.

The extension, which may be in stages of from one inch to twelve or fifteen feet, or the limit of the machine takes place by turning a small hand wheel (23 on sketch), which operates a pinion on a rack fixed to a sliding rail (13). The conveyor can be extended while running and practically on load, as the conveying belt always remains at the same tension. Take note of the position of pulleys 15 and 16 on the closed view of the conveyor and also on the extended view, and it will be seen how this is possible. The carrying rolls only have to be put on or taken off as necessary.

As inclined portable conveyors of over twenty four feet in length are too cumbersome to be of much use,

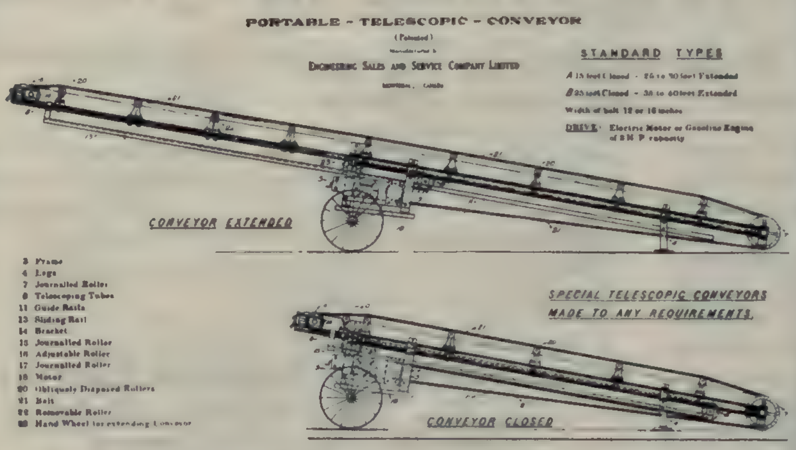
PORTABLE - TELESCOPIC - CONVEYOR
(Patented)
Engineering Sales and Service Company Limited
STANDARD TYPES
A 15 feet Closed - 25 to 30 feet Extended
B 25 feet Closed - 38 to 40 feet Extended
Width of belt 12 or 16 inches
DRIVE: Electric Motor or Gasoline Engine of 3 H. P. capacity
CONVEYOR EXTENDED
3 Frame
4 Legs
7 Journalled Roller
8 Telescoping Tubes
11 Guide Rails
13 Sliding Rail
14 Bracket
15 Journalled Roller
16 Adjustable Roller
17 Journalled Roller
18 Motor
20 Obliquely Disposed Rollers
21 Belt
22 Removable Roller
23 Hand Wheel for extending Conveyor
SPECIAL TELESCOPIC CONVEYORS MADE TO ANY REQUIREMENTS.
CONVEYOR CLOSED

Fig. 2—Diagrammatic sketch of telescopic conveyor.

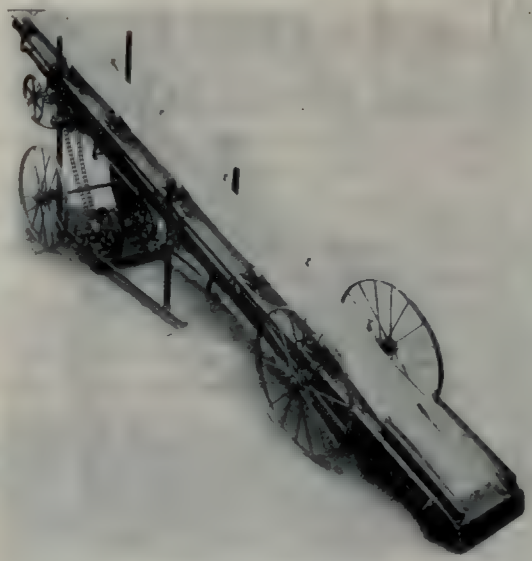

Fig. 3—The complete equipment.

it is only by the telescopic principle that a forty-foot conveyor is practicable.

The telescopic conveyors are designed for horizontal or elevated delivery and are fitted with twelve inch or sixteen inch belt on troughed or straight rollers Motive power is supplied by either a gasoline engine or electric motor, making the conveyor completely self-contained and an independent unit.

One important feature is that the telescopic conveyors are entirely of Canadian manufacture throughout. They are obtainable through the machinery houses and dealers, and are manufactured by the Engineering Sales & Service Co, Ltd., 177-179 Duke Street, Montreal,

Figures 2 & 3, show a 25 ft. to 40 ft. telescopic conveyor designed for a special service.

# Defense of the Drifting Sand Filter Plant at Toronto

By James Milne, Electrical and Mechanical Engineer, Water Supply Section, City of Toronto.

[In the Contract Record of February 9, 1921, Mr. Milne, the author of the present article, presented an analysis of the operation of Toronto's drifting sand water filter plant, as embodied in a paper submitted to the annual meeting of the Engineering Institute of Canada. This paper excited considerable comment and discussion, Mr. Hazen of New York, the designer of the slow sand filter at Toronto, taking strong objection to Mr. Milne's statements. A summary of Mr. Hazen's comments also appeared in our issue of February 9. In this present article, prepared for the transactions of the E. I. C., Mr. Milne answers Mr. Hazen and upholds his own original contentions regarding the drifting sand filter—Editor.]

It was the authors desire to place before the members of the institute a fair and just statement of costs and operating conditions of both sections of the Toronto Filtration Plant. The author is directly responsible to the Commissioner of Works for its proper maintenance, and he did not show any favor or disfavor to either type.

Touching briefly on the capacity of the slow sand plant, he finds upon looking up the records that there were two occasions when slightly over the 50 million gallon rate was reached, and on each occasion the pure water reservoir was practically empty. It was an utter impossibility, however, to continue the rate, and the plant shut down (1912) the following day.

With further reference to Mr. Hazen's remarks on the upkeep of the slow sand plant, this would, under good conditions, be a simple matter, but with the Toronto design it is not. In one instance stop-logs were provided instead of a proper gate valve, and flow control could not be obtained, without closing down the plant. The draft tubes of the raw water pumps, owing to improper bracing, moved from their original position.

The roof of the engine and boiler rooms must be rebuilt this year, at a cost exceeding $10,000, as the design was too light.

While it is stated in the paper that turbidity has not seriously affected the output of the slow sand plant, this referred to the safe capacity of 32 million gallons per day. If higher rates are attempted the turbidity reduces the capacity from 30 to 50%.

Since the paper was written a rate of 36 million gallons per day was reduced over 30% for a considerable time, although the staff engaged in cleaning was doubled immediately and were constantly employed, (24 hours daily) until conditions became normal.

Mr. Hazen lauds the bacteriological efficiency of the slow sand plant and deplores the output. Many tests in recent years show that when the rate of filtration exceeds 4 million gallons per filter, or 5 million gallons per acre, the efficiency has been seriously and considerably impaired. The results in this respect might not favor the slow sand plant if the output could be increased to that desired by Mr. Hazen.

Mr. Hazen again draws a wrong conclusion when he states "that the slow sand filters were more adequate in protecting against the effects of the heavy pollution." This refers to that section of the paper which states: "In 1920, however, owing to the heavy pollution and scarcity of alum the steam auxiliary was used at times." Extra pumping expenses were not incurred to send more water to the slow sand plant, owing to the heavy pollution affecting the quality of the output, but simply to conserve alum, of which we were short, owing to market conditions.

Mr. Hazen disagreed with the author that the plant was too small for the Citys requirements from the time it was put in commission. The author replied verbally to this. It might be interesting to quote from a letter written to the city engineer 2½ months after the slow sand plant was put into use, by Mr. Hazen dated March 18th., 1912,—

"........The records for the last two months indicate a large increase for the present year. The filters were not designed to meet such a rapidly increasing rate and must be enlarged at once if the increase is to be kept up...... There should be no effort to restrict legitimate using of water at any point. It is only the useless waste that needs to be stopped. This can be stopped by well known methods without detriment to any one, and if this is done the plant, as now constructed, is plenty large enough for present needs and for some years in the future. **Under present conditions the plant is too small.**"

Mr. Hazen referred, no doubt, to the metering of the consumers. It may interest the members to know that a Pitometer survey of the City in regard to waste prevention commenced October 1911 and continued until 31st. of January, 1917. Fom this it will be seen that, outside of metering the city, every means were taken to reduce wilful waste.

In No. 1 of the conclusions it is stated that "it is questionable if the 10% reduction made on the cost of labor and materials on the drifting sand plant is sufficient to reduce same to the equivalent cost basis of the slow sand."

On reconsidering this, and knowing the difference that exists between the buildings and equipment in both sections, and having due regard to what Mr. Gore stated the author now thinks that 20% reduction would be justified, the following would therefore give the corrected costs for comparative purposes:—

| | Slow Sand | Drifting Sand |
|---|---|---|
| Amount stated in paper ........ | $943,522,35 | $1,203,036,50 |
| Deduct 20% of cost of drifting sand plant to compensate for excess cost as against time and conditions when slow sand plant was constructed ............ | 18,236,72 | 224,451,30 |
| | $925,285,63 | $978,585,20 |
| Cost per million gallons on safe average daily capacity ........ | 28,915,00 | 19,251,70 |
| Annual interest, payable in 30 years, 5% debenture, 3% sinking fund .................... | 65,695,28 | 69,479,55 |

The difference in interest and sinking fund affects the cost of filtration, as calculated on the equivalent basis.

The following, therefore, should be substituted, viz:—

| | Slow Sand | Drifting Sand |
|---|---|---|
| Cost of administration, operation and maintenance, as before ........................ | 148,940,17 | 292,984,96 |
| Interest and sinking fund for 2 years ..................... | 131,390,56 | 138,959,10 |
| | 280,330.73 | 431,944.06 |
| Cost of administration, operation and maintenance per million gallons................ | 7.29 | 11.59 |
| Interest and sinking fund per million gallons............... | 6.43 | 5.50 |
| Total cost per million gallons | 13.72 | 17.09 |
| Ratio of costs per million gals. | 100. | 124.5 |

The revised costs on both sections of the plant, working at capacities of 32 and 50 million gallons, respectively, with interest and sinking fund based on equal financial rates and construction costs, would be as follows:—

| | Slow Sand | Drifting Sand |
|---|---|---|
| Cast of administration, operation and maintenance, as before ........ ...... ........ | 148,940.17 | 292,984.96 |
| Additional cost for 2 years, as before ...... ................ | 5,000.00 | 52,100.00 |
| Interest and sinking fund (revised ......................... | 131,390,56 | 138,959.10 |
| Total ...... ...... ...... | 285,330.73 | 484,044.06 |
| Total cost per million gallons | 12.21 | 13.26 |
| Ratio of costs ..... ........ | 100. | 108.6 |
| By pre-chlorination we have on the drifting sand cost per million gallons, administration, operation and maintenance.... | | 8.08 |
| Cost per million gallons, interest and sinking fund ...... | | 3.80 |
| Total cost per million gals .... | | $11.88 |
| Cost by slow sand per million gals. under very best operating conditions ........ ...... .. | | $12.21 |

### Pre-Chlorination.

We estimated that by chlorinating prior to filtration a saving of $25,000 per year could be affected. Trial conducted during the first three months of this year tends to confirm this. We shall be in position to definitely advise after one year's experience.

The average amount of alum used during the period covered by the paper (1918-1919) was 1¼ grains per gallon. From January 1st. to March 31st., with prechlorination the dosage approximated 4 grains per gallon, a saving of 68%.

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The Dayton-Dowd Company, manufacturers of centrifugal pumps, Quincy, Ill., are distributing bulletin No. 246 describing their approved underwriters centrifugal fire pump. Of particular interest are the numerous photographs of installations and tests shown in this bulletin.

# Fall Letting of Highway Contracts

## Present Practice of Awarding Road Work in the Spring Leads to Waste and Inefficiency—Advantages of Planning Ahead

A vast amount of waste and inefficiency in highway construction, much of it unavoidable, is attributed by engineers and contractors engaged in that industry to the present practice of awardng contracts in the spring. An interesting analysis of the advantages of letting these contracts in the fall was prepared by the research department of the Associated General Contractors at the request of Mr. Herbert Hoover, U. S. Secretary of Commerce. The analysis practically in full is printed below.

Adherence to the practice of awarding contracts in the spring through which a large portion of the construction season is not utilized has so curtailed the working time that construction companies cannot execute the mileage warranted by their elaborate organizations. The investment in equipment used in Illinois in 1919 is estimated at approximately $6,000,000, yet this equipment was able to operate at capacity for but one week during the season. When constructors have succeeded in pushing the work of grading to a point where concreting may begin, the season is well advanced; and by the time their organizations are functioning to capacity, fall is at hand and operations must shortly begin to close down for winter. A record of lettings in Iowa over a period of 10 years shows that the average date of letting was April 15, and that concrete was poured about a month and a half later.

The realization that construction ought to utilize the full season by an earlier start has been brought about principally by the recent development of hard surface roads. In former years when contracts covered but small sections of road and when road building plants were comparatively simple, the loss of two months at the start counted for little. Now, however, since a phenomenal development of roads has introduced elaborate specialized equipment and has occasioned a yearly expenditure exceeding the cost of the Panama Canal, the matter of longer seasons is an important consideration.

### More Work By Early Letting.

In 1919 the first contracts for Illinois roads were awarded early in May, and but little concrete was placed before July. Production steadily increased until October when the maximum was reached. One week after reaching the maximum it dropped off rapidly to zero. On account of the late date in arriving at capacity production, only 172 miles of road were built, and about 600 miles were carried over to the following year, uncompleted. The results of that year, however, were radically different. Conditions in 1920 were approximately those existing under fall letting. Very few contracts vere let in the spring, and by reason of work carried over constructors were able to begin operation at the first opening of spring. In consequence of this early start, concrete work began in April, two months earlier than in the previous year, and reached a heavy volume by June. During June transportation failed and the lack of materials disrupted the work. Had this not occurred, the indications are that peak production would have been reached in July and continued with slight fluctuations until October.

In spite of the transportation failure about 350 miles of pavements were laid and but 192 miles left uncompleted. This means that in 1920 when construction companies were able to start early with well laid plans, they built 100 per cent more road than in 1919, and did it in spite of the most trying transportation difficulties.

The customary procedure of most state highway departments has been to ask for bids in the spring—often as late as May. By that time many working days have already been lost and before contracts are awarded further delay occurs. Such losses frequently total as much as 14 weeks. The average number of working days in the central states under spring letting has been found to approximate from 110 to 120, and since the 14 weeks lost contain 25 or 30 days on which weather conditions permit work, the seasons might readily be increased 20 per cent. In other words, with an early start road building units can operate 140 days in the year instead of 115. The record for pouring concrete in Illinois in 1920, when work was repeatedly held up for lack of materials, was 131 days. This, however, does not exactly represent the full number of working days in the season, as concreting was repeatedly stopped for lack of materials.

In order to reduce the fluctuations in construction activity and to eliminate the waste resulting from such seasonal expansion and contraction, it is proposed that state highway departments call for proposals and award their contracts during the fall. This procedure is desired not only to extend the working season but to develop the possibilities of interseasonal work.

### Disadvantages of Fall Letting.

To determine the full effect of abandoning the present custom of spring lettings, discussion on the subject has been carried on with engineers and contractors in many parts of the country. This discussion, which has brought out two objections to such a plan, shows six advantages that would accrue to the construction company, the workmen and the state. The objections are: first, in a declining market the state would pay more for work under fall contracts than those awarded the following spring; and second, the highway departments need a slack season in which to make surveys and plan their projects for the coming year.

Prospects of a rapidly falling market must undoubtedly be considered in letting work, although by the same principle spring contracts might well be withheld for lower prices in the following fall. When prices are practically stabilized this consideration, of course, would not enter and the economics otherwise affected would probably outweigh any minor changes in material prices. The second objection pertaining to the need of highway departments for a slack season in which to plan and make surveys, was not considered serious by the engineers consulted, as they felt that state departments might readily readjust their organizations to handle the work, and especially so, since the process would probably reduce the engineering charges per mile of road. Unless more serious obstacles to fall letting are found, the objections may rightly be termed insignificant.

### Advantages of Fall Letting.

The advantages on the other hand are so far-reaching in effect that they cannot longer be ignored. They are as follows:

1. Relief of car shortage between July and October.
2. Employment of labor in slack months.
3. Reduction of seasonal fluctuation in construction.
4. More continuous production of materials.
5. Increased efficiency in road building.
6. Completion of highways as planned by road departments.

### Relief of Car Shortage.

Transportation, the first factor mentioned, constitutes probably the most difficult item with which road builders have to contend. Its failure in 1920 cost them many thousand of dollars and if any means is found whereby a steady supply of materials can be assured, great economy will be introduced. Such a means can at least in part be furnished by beginning work early in the spring, thus starting the movement of materials at an early date and reducing the peak demand for open top cars in the late summer. It was this peak demand, contributed to by all industry which disrupted construction in 1920.

One of the most difficult problems with which the railroads have to contend is the transportation peak load, occurring between June and October. Much traffiic is seasonal of necessity, and much other which might easily be handled earlier in the year, places upon the carriers during these months a load which they are scarcely able to carry. In 1920 the situation became so acute that many shippers, especially material manufacturers, were able to secure but a small portion of their needs. The reasons for this situation and the danger of its recurrence are shown by the reports of the carriers.

In 1917 the Class 1 carriers had about 2,479,000 freight cars in service, but by 1920 this number had decreased 126,000 with 310,000 cars in bad order. Recent reports from the carriers show that they now have 134,000 cars less than at the transportation peak of 1920. Therefore, it is essential that every industry take action, wherever possible, towards relieving the congestion of late summer. Such action would greatly aid the carriers and enable them to give better service to all shippers.

If contracts were awarded in the fall, construction companies could not only give aid in the transportation problem by making certain shipments in winter and spring, but could also give continuous employment to part of their employees.

### Slack Season Employment.

On account of the seasonal character of construction, which is one of the most seasonal industries, each year witnesses an enormous fluctuation of activity. In those states which are not favored by a mild climate, an elaborate organization is assembled in the spring and a few months later is scattered as work closes down in the fall.

Workmen thrown out of employment by the closing down of construction must seek employment in other industries at a time when other industries do not need them, and under the best of conditions they may lose a great amount of working time. This lack of employment is in part accountable for much of the turnover between construction and other industries. Any action whereby more continuous employment can be furnished will doubtless draw more competent men into construction and raise the efficiency of those already so engaged.

Construction companies could, if awarded contracts before winter, so lay out and execute their preliminary work that winter employment could be given to a considerable number of men. Heavy grading could be carried on, materials could be stock piled to insure a continuous supply, and material distribution plants could be assembled. In this way the preliminary work could be completed before concreting weather arrived, and capacity output could be reached early in the season. Each part of the work that can thus be carried on during the off-season helps to stabilize construction activity.

### Seasonal Fluctuation in Construction.

Elimination of the waste in any industry which results from spasmodic or heavy peak demand for production, has for many years been the subject of careful study by public service and other corporations, but until very recently, the same factors in the construction industry have received but scant attention. And yet it is doubtful if any other industry offers a more fruitful field for improvement in peak load inefficiency.

Construction activity in the Central and Northern States must on account of climatic conditions be subject to wide variations. But even in those states the amount of work that can be performed outside of the period now commonly regarded as the construction season, is sufficient to materially reduce the almost feverish activity of late summer and autumn, and by such reduction to affect the economics which arise from more uniform operation.

Both engineers and contractors have learned that a great deal of construction formerly held until late spring can be safely and economically executed during the off season. In fact, the last three years have witnessed a great amount of reinforced concrete building carried on through the severest weather. This of course, is not advocated in the case of concrete road construction, but there is, however, a great part of the preliminary and indirect work of highway building which could be completed during the winter and early spring months if contracts were awarded in the fall of the year.

### Continuous Production of Materials.

Seasonal fluctuations occur not only in the construction industry itself, but in the basic industries supplying its materials, and in a general way benefit which accrues to construction reacts also to the benefit of the basic industries. Their problems of labor supply and overhead are almost alike. By lengthening the construction season the operating season for various producers of material is also increased. Two months added in the spring to construction would mean also two months added to the season for producers of gravel, crushed stone, and brick. Their overhead cost would be reduced accordingly and would reflect in the cost of finished roads. Material producers, like construction companies, would be better able to anticipate the market, provide for equipment and lay plans for adequate prduction.

### Increased Efficiency in Road Building

Through the combined influence of all factors affected by fall lettings, a general reaction toward efficiency in construction would ensue. More efficient operation is now being studied by many engineers who have taken up contracting as a profession, and their discussion has shown a number of places where improvement is needed.

To begin with, considerable heavy grading can be done between months of November and April, thus enabling a construction company to retain the nucleus of a permanent field organization. These men could be utilized also at other preliminary work to eliminate much of the dead time in winter during which the permanent field organization draws pay. Another saving can be made in equipment expense. Contractors, upon completion of their work in the fall would not find it necessary to remove their equipment, ship it to the storage yard and then reship it in the spring, but could ship direct to new work. The freight of at least one shipment, and loading expense involved, are in that event eliminated.

Probably the greatest improvement is made possible by the opportunity offered for careful investigation and planning during the slack winter months, and the possibility of retaining a larger number of well trained men. One of the most common sense causes of inefficiency upon the part of construction organizations during the past year has been the lack of skillful mechanics to operate and maintain the specialized road machinery now in use. Inexperienced workmen have frequently broken machines which delayed operations of the entire plant. Any plan whereby construction companies will be enabled to retain mechanics and instruct them over winter will react to increase efficiency. Such a plan can be put into effect if contractors know in the fall what work they will have in the following spring.

### Completion of Planned Highways.

The efficiency of a road-building unit, while of interest to the state highway engineers, is not their most vital concern. They are interested first in seeing that the state receives the road which is contracted for and receives it on the date expected. Very few contracts the last two years have been completed on time. If the conditions of 1920 in Illinois could be approximated in other states; that is if the work could start without the usual delay of spring letting, several contingencies of construction would be avoided, and the various highway departments would doubtless be able to carry out their work so planned. The opinion has been expressed by engineers of the Illinois Division of Highways that, had the material supply not failed, it would have been possible with the early start of 1920 to build twice the mileage constructed that year, and build it, moreover, without additional administrative charge and with very little overhead expense to the constructors.

Illinois thus gives evidence of the advantages which accrue from an early start in the spring, and their effect upon the volume of work performed. The conditions anticipated by engineers and contractors have been so closely verified in that state under conditions assimilating fall letting that its advantages are no longer to be doubted.

# The Time of Set of Concrete

## The Various Factors Affecting this Important Property are Detailed—Manner of Measuring Set—Practical Application of the Flow-Set Method

By Watson Davis, at the annual meeting of the American Society for Testing Materials.

The "time of set" of concrete is an important property to which little attenion has been given. Specifications for the time of set of neat cement, the principal active ingredient of concrete, have been formulated and used. Much investigational work has been done using the Vicat and Gillmore-needle methods of measuring time of set of neat cement, and the literature is filled with reports of settng time tests of neat cements of "normal consistency."

But a measure for the setting qualities of concrete and mortar, the forms in which cement is used commercially, has not been developed heretofore. This paper presents a method, which may be called the "flow" method, for measuring time of set or rate of stiffening of concrete.

Briefly, the method consists of determining the time at which the concrete ceases to "flow," or when it is no longer plastic. This is accomplished by using the "flow table," an apparatus developed at the Bureau of Standards for measuring the consistency of "flowability" of concrete.

The "flow table" is a table-like apparatus consisting of a rigid frame with a top mounted on a vertical shaft so that it can be jolted or allowed to drop through a fixed height by means of a rotated cam. A mass of concrete usually in the shape of a disk or truncated cone, is placed on this table top, jolted a given number of times and its increased diameter measured by means of calipers. The diameter after jolting divided by the original diameter and multiplied by a 100 gives a figure which is a criterion of "flowability" or consistency.

The flow test for consistency of concrete and the flow test for time of set of concrete are intimately connected. In the test for time of set, the rate of decrease in flow is measured as follows: A number of disks of concrete are moulded and at stated time intervals after mixing are tested in succession for flowability. At the beginning of the test the disks are jolted at intervals of an hour, but the intervals between jolts are decreased as the flow decreases. As the concrete stiffens the flow decreases, and the time at which the point of no flow is reached is considered the time of the set of the concrete. In practice, a flow of 105 is usually considered the point of no flow.

That the wetter the consistency the slower will be the set seems to be a general law, so long as cement, mix, and aggregates are the same. In every case in the data obtained an increase in initial flowability of a given mix is accompanied by an increase in the time of set. Except for the influence of the setting quality of the cement itself, excess water producing concrete is the most important factor in influencing the time of setting of concrete. The retardation of set is most marked in the leaner mixes. Tests of 1: 1½: 3 concrete gave time for set for wet consistency 5.5 hours, for medium, 3.0 hours and for dry, 1.25.

Tests on neat cement gaged with 22, 23, and 24 per cent of water indicate that for each per cent increase in the gaging water the time of set is lengthened on the average about 20 minutes. Time-of-set tests on neat cement using 25 and 30 per cent of water also confirm this conclusion.

### Effect of Richness on Set.

A rich concrete will set faster than a lean concrete, providing the two concretes are of the same consistency or initial flowability and are made of the same materials. Neat cement, 1 : 1½ : 3 concrete, and 1 : 3 : 6 concrete of approximately the same relatively wet consistency were tested. Four tests of each mix on different days were made. The neat cement set in 4.25 hours, the 1: 1½: 3 concrete set in 5.6 hours and the 1 : 3: 6 concrete set in 6.75 hours.

### Effect of Character of Cement on Set.

The character of the cement is undoubtedly the most important factor that influences the setting time of concrete. Variation of gypsum content, method of manufacture, raw materials and fineness all effect the setting properties of the cement and these properties of the cement are reflected in the concrete in which the cement is used. In view of the fact that it is generally recognized that cements of different character may have widely different setting times, the tests were not carried to the point where they would be rigorously conclusive, and represent results of single tests only.

Cement U is a natural cement that is fairly quick-setting. Cement L is a Portland cement that has normal setting properties, while cement S is a Portland cement that is abnormally slow-setting. Setting tests of these three cements in a neat mix are: Cement U—1.9 hours; cement L—3.5 hours; and cement S.—7.5 hours. The percentages of water determined by the routine specification test for "normal consistency" made by the Vicat needle were used. Results of using these cements in 1 : 2½ : 3½ concrete are: With cement U time of set was 3½ hours, with cement L, 6 hours and with cement S, 7 hours.

While the setting properties of the cement determine in a large measure the setting properties of the concrete, in general, the differences between the setting times of concretes have a tendency to be less than those between the setting times of corresponding neat cements. For the other tests normal setting cements were used.

### Relation of Time of Set of Neat Cement and Concrete.

As pointed out above, neat cement sets faster than the concrete made from it. Conditions of temperature, aggregate, cement content and consistency materially affect the setting time of concrete, and while the setting properties of the cement as determined by a needle test on a neat mix of normal consistency are reflected in the concrete, they are changed and influenced by the conditions peculiar to the concrete. For these reasons it is believed that to determine the setting properties of concrete, tests must be made on the concretes themselves.

### Effect of Calcium Chloride on Set

Two calcium-chloride solutions were used with 1 : 2 : 4 concrete. One referred to as "Compound X" is sold under a trade name and is approximately a 30 per cent solution of calcium chloride. The same cement, aggregates, proportions and consistency were used in all mixes compared, and the calcium chloride was the only variable introduced. In all cases the 4 per cent calcium-chloride solution caused the set to take place in about half the time required by corresponding mixes gaged with plain water. The two calcium-chloride solutions from different sources, but of the same concentration, had practically the same effect on set.

### Effect of Temperature on Set.

All test specimens were moulded from one batch of 1. 2½ : 3½ concrete under normal temperature conditions and then subjected to the temperatures and conditions stated in the figure. Both the high and low temperatures are often met with in practice. The "low" temperature was just above freezing, while "high" temperature corresponds to that sometimes experienced in midsummer. Concrete at "low" temperature took over 2.5 times as long to set as that at high temperature, and the concrete of normal temperature set 4 hours before the cold concrete, and 1½ hours after the "high" temperature concrete.

Strength tests on 3 by 6-in cyclinders kept 24 hours under the different temperature conditions were made and the average of three tests at 24 hours under each condition showed that at high temperature the strength was 2.5 times normal temperature strength and at low temperature the strength was one-sixth that at normal temperature.

While it is possible that concretes made of cements of different composition and manufacture would not always exhibit these large differences in set and strength due to temperature, undoubtedly the results presented are indications of what may be expected. In general the lower the temperature the slower a given concrete will set, and the higher the temperature, the faster it will set.

### Method of Measuring Set of Neat Cement.

Tests indicate that the flow method gives times of set that are somewhat earlier than those for initial set given by the Gillmore needle and that time of initial set by the Vicat needle is about the same or slightly earlier than the initial set by the Gillmore needle.

The flow method of measuring time of set is fundametally different from the Gillmore and Vicat methods. In the Gillmore test only a portion of the outer surface of the pat is tested. The Vicat test depends upon the penetration of a needle into a relatively small portion of the pat. When the flow time-of-set is jolted on the flow table, the entire mass is affected.

The flow method could be used for routine method setting tests of cement. Two set test pieces could be made of normal consistency paste and one tested at one hour and the other tested at 7 hours. Provision could be made that a flow of 105 should not be reached when 1 hour old but that it should be reached by the end of 7 hours.

Incidentally it is believed that the flow table is a better apparatus for use in determining "normal consistency" of neat cement than the Vicat apparatus.

### Nature of the Flow Changes Occurring during Setting.

The rate of the change in flowability that takes place during the setting time seems to be influenced by the consistency and cement content of the mix. When the mix is of small initial flowability or is rich in cement content, a large part of the flow (50 to 75 per cent) is lost in the first hour after mixing. When the mix is of wet consistency and has a small cement content, the decrease in the first hour after mixing is smaller on a percentage basis, but during this first hour the rate of decrease is usually higher than during any other period. A probable explanation of these initial decreases is that they are caused by a combination of setting and absorption. The cement and aggregate gradually absorb water during this period, thereby doing their share of decreasing the flowability.

Tests not reported show comparatively rapid decrease in flowability determined at short intervals (3, 5 and 10 minutes) after mixing, showing that there is a stiffening of the mix due to absorption in the first few minutes during and after mixing. While this absorption of water is comparatively more rapid in the first 10 minutes during and shortly after the mixing, the absorption is probably not completed then. Although diminished, it probably continues through the first hour or more after mixing, and combined with a true setting action, causes the initial decrease referred to above.

It was thought that the relatively large decrease in flowability noted above might be due to an actual loss in water by evaporation or other cause. Weighings of several test specimens of the various series were therefore made to determine their possible loss. While specimens stored in air at low humidity showed losses of water, those stored in the moist cabinet at high humidity did not. As initial losses in flowability are noted in both cases it is concluded that loss of water is but a minor contributory cause. It was noted that a considerable loss was due to leakage of water from the test specimen in the case of the wetter mixes, and not to evaporation.

### Early Strength as a Measure of "Final Set."

That flow time of set corresponds approximately to the initial times of set by the needle methods when used for neat cement has been shown in data presented above. But the final tests by the needle methods can be applied only to neat cements, and even then are of no real use and require much time to complete. The test needed is one that will tell the condition of the concrete at an early age and give definite information that can be used in deciding when to pull forms, or to perform some other operation. A compressive strength test at an early age, say 24 hours, will give such information. A test of this kind is suggested as a substitute for tests of final set.

Early strengths necessary for different purposes could be determined and specified. Some cases where such a test would be important are to determine time for removal of forms, ability to carry the dead load of structure, and the opening of concrete-paved sidewalks and streets to traffic.

There is no general relation between time of set and strength. Some tests show that the fastest setting mixtures are the weakest while the slowest setting ones have the next highest strengths. In the case of calcium chloride accelerated mixes those that set fastest are also the strongest.

### Uses of Flow-Set Method.

Probably the chief use of this method of making time-of-set determinations of concrete will be in investigational work in concrete to determine the effect of various factors on set. It is also capable of being applied practically. This is shown by the following example.

A floor was being laid, and a 1 : 2 mortar topping accelerated by using a calcium-chloride solution for gagging liquid was used for one portion, while the rest was laid with mortar gaged with plain water. Flow set determinations were made and the opinion of the finishers was obtained . This test brought out the fact that a mortar of a flow of about 190 could be wood-floated, while when it had a flow of about 140 it was in about the right condition to finish with a steel trowel. Once these flow constants were determined for the table and mold used, preliminary tests could determine very closely the time at which floating and finishing could be begun.

There is a certain minimum consistency or flowability of concrete that can be used for certain purposes, such as in a reinforced concrete building, and the length of time that the concrete retains a flowability greater than the minimum can be determined by the flow method.

Undoubtedly this method of measuring time of set can be applied to measuring the rate of stiffening of limes, plasters, clays, etc., and other plastic materials.

### Other Factors Affecting Set.

Factors other than those that have been investigated undoubtedly affect the time of set.

The kind of aggregate, depending largely on its absorptive properties, will probably be found to influence the setting. Concretes made of absorptive clay, slag, and stone aggregate will probably set faster than similar concrete made of non-absorptive quartz aggregates.

Similarly, the moisture condition of the aggregate will tend to affect the set of the concrete. Wet aggregate will probably accelerate it slightly.

The gradation of the aggregate, the fineness of the sand and the relative amount of course aggregates may have some effect on set, and this is a field for future study. The change in setting time caused by the addition of different salts, ad-mixtures and proprietary compounds may be determined by the method described.

It s believed that humidity has little effect on set, although no correlated data are presented on this factor it should be noted that the whole test specimen is used in the flow-set test, and that for that reason, surface drying caused by low humidity probably does not materially affect the result. Humidity probably does affect the results of the Gillmore and Vicat methods of determiniing the time of set of neat cement as these tests are made on the surface rather than the body of the test specimen.

# Concrete Bins and Pits for the Storage of Coal

## The Portland Cement Association Offers Suggestions for the Maintenance of a Coal Supply in Connection with Industrial Plants—Methods of Storage

Probably no other industrial situation that existed during the past two or three years so seriously threatened our economic life as did the irregular or deficient coal supply. Some time during that period practically every manufacturing plant found itself confronted by indefinite suspension of operation. One can hardly imagine that any greater hardships could be imposed upon the country than would come from paralysis of industry due to absence of coal supply. Everyone is constantly dependant on uninterrupted normal manufacture and distribution of food, clothing, heat, power, light and other commodities that are essential to life itself—so availability of coal for continuous operation is all important.

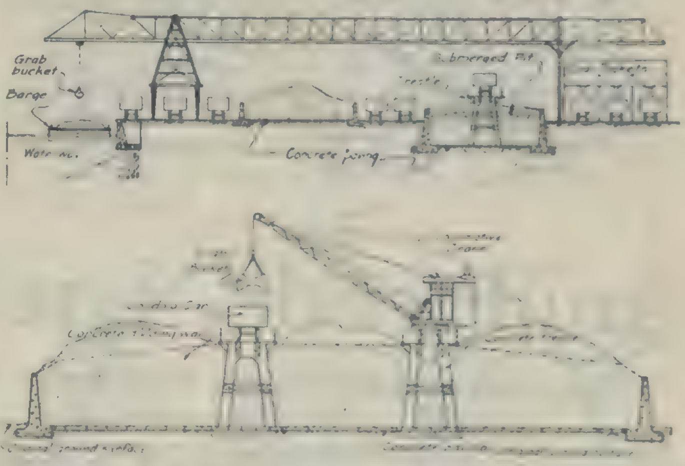
No manufacturing industry would expect to operate successfully without having arranged for sufficient stocks of raw materials entering into its finished product, to prevent danger of their depletion below certain established requirements, thus insuring uninterrupted production. Yet frequently an industry fails to anticipate and safeguard its fuel requirements—and without fuel no stock of raw material can be converted into the desired finished product. Coal storage, which means power insurance, is therefore insurance against shutdowns. Anything that interferes with continuous production means a loss. Not all of this is expressed by loss of profits during the time of an enforced suspension of operation. There must be added overhead and fixed charges, loss in efficiency in production due to disorganization of working forces and delayed delivery on contracts with possible resultant loss of valuable patronage—often secured at considerable expense; that there are other losses none the less real every industrial operating executive knows.

Every coal user should arrange for some storage. Domestic consumers use in the aggregate but a relatively small percentage of our total coal production, yet they should be prepared to store the greater portion of their annual requirements at any time their dealer is prepared to deliver it. Every important industry using any considerable amount of coal should in normal times keep a supply sufficient for at least thirty to forty days' operation. With such a reserve the industry is independent of deficiencies in supply caused by railroad congestion or mining difficulties. In such cases daily deficiencies in receipts can readily be made up from reserve in storage until increased shipments enable replenishment of reserve to normal capacity. Coal storage is thus the balance wheel which keeps the machinery of production going without interruption.

Storage of coal by industrial plants is also needed for reasons other than insuring continuous operation. Advantage can be taken of the most favorable price inducements that coal operators may be disposed to make contingent on delivery any time during a stated period. Such inducements are usually made because it is known that during certain periods more transportation facilities will be available. With such an understanding between coal producer and coal consumer, the former can plan his operations sufficiently in advance to take advantage of any subsequent surplus of transportation.

### Storage Repuirements and Methods.

Storage requirements and the methods of storage are largely determined by the kind and quantity of coal to be stored. In some bituminous coal mining regions there are large quantities of relatively low grade coal which many industries could use profitably. Yet these coals are not used as extensively as they might be simply because industrial plants have failed to provide proper storage facilities for them. Many of these coals contain proper heat value, yet because of chemical content are readily subject to spontaneous combustion when improperly stored in large quantity. In such cases the storage problem is simply one of keeping the fuel submerged in water. Such storage facilties are of simple construction. They involve only watertight, concrete lined pits in which the coal can be kept constantly submerged until required for use. Under such conditions of storage these low grade coals can neither ignite in storage nor while so stored lose any of their heating value, which might occur in open air storage.



Upper: Combination of submerged and open storage with unloading bridge; especially adapted to points of transshipment from water to railway transportation.

Lower: Parallel trestle type of open storage. Coal is dumped from cars on trestles and is distributed and reclaimed by locomotive crane working on either track. The longitudinal retaining walls increase storage capacity for given areas. The dividing walls allow separation of various grades of coal and serve to confine any fire from spontaneous combustion to the compartment where it originates.

Among the points to be considered in the storage of coal by the individual industry are:

Space suitable for storage.

Convenience and economy of handling in and out of storage.

Convenience with respect to point of consumption and handling equipment.

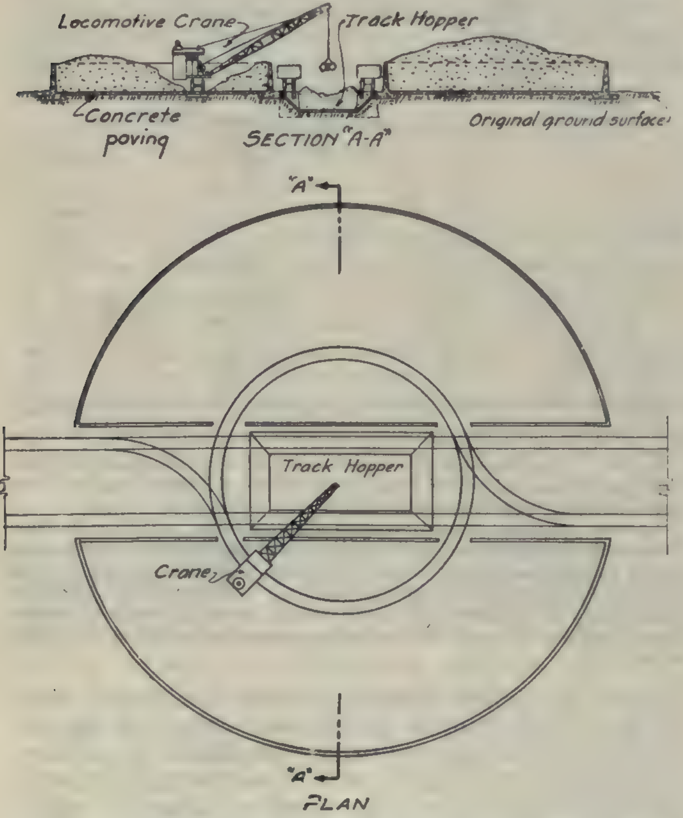
Convenience and economy of handling in and out of of storage are prime requisites for large industrial plants and for public utilities. Facilities should permit moving as much of the coal as possible, direct from storage to bunker or firing floor.

Elevated bins near the point of use are particularly convenient as coal may be discharged from them by gravity for firing by automatic stokers or by hand. Elevated bins are ideal for storage by retail dealers. If such bins receive coal from track hoppers, the cost of handling will usually be less than from open-ground storage.

Large piles in open air storage should have concrete enclosures and dividing walls so as to economize space and localize fire which may start from spontaneous conbustion. Accompanying sketches suggest several methods of open air storage.

The parallel track type without trestle, employed for storage on a large scale, requires locomotive cranes or conveying equipment for unloading, storing, reclaiming and for transporting from storage to place of use.

The trestle type allows dumping directly from trestle, and in conjunction with portable handling and conveying equipment can be used to store coal over a considerable area each side of the trestle

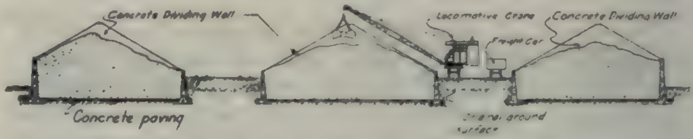


Circular type of open storage. Coal is dumped from bottom dump cars into track hopper and is distributed and reclaimed by locomotive crane working from circular track. Maximum storage for given ground area is obtained by placing exterior circular retaining wall at a distance from circular crane track slightly greater than reach of crane.

Circular storage is especially applicable where available ground space is square or nearly circular in shape.

Where coal is received from boats, the moving bridge type unloader, or hoisting tower with flight conveyors is usually adopted. In such cases open storage may be combined with under-water storage. All grades and mixtures of coal can be stored under water with positive assurance that no loss will be suffered from any cause.

Sidehill storage may be found most economical where there is considerable slope to the natural ground surface adjacent or convenient to the point of use. A fairly uniform slope covered with concrete paving and having concrete dividing and retaining walls, and equipped with gates and chutes, will provide for loading directly from storage to cars by gravity, or in special cases for chuting directly to boiler house bunkers or bins.



Parallel track type of open storage. Concrete enclosure and dividing walls conserve ground space and make possible flooding one or more compartments in case of spontaneous combustion. Excavation from pits is used in embankment for tracks thus increasing storage capacity for a given area.

### Effect of Storage on the Properties of Coal.

Extensive experiments in coal storage have been made by the University of Illinois Experiment Station and U. S. Bureau of Mines. Circular No. 6 and Bulletin no. 116 of the University of Illinois Experiment Station, by Mr. H. H. Stock, and Technical Paper 235 of the U. S. Bureau of Mines, also by Mr. Stock, summarize the results of these experiments in coal storage and the fundamental factors to be considered in providing for storage.

It has been proved that the firing qualities of coal are not affected in any important degree by storage, also that any important slowness of combustion from storage is readily overcome by regulation of draft and by modified firing. The coke and gas making qualities of coal are little, if any, affected if the coal does not heat in storage.

Any considerable breakage of coal as a result of handling is objectionable for some uses and also increases the tendency to spontaneous combinstion, but unless breakage goes so far as to increase largely the percentage of "fines," it is of little importance.

The depth of the pile is important from the standpoint of handling or loading out in case of fire.

### Spontaneous Combustion.

Anthracite coal is rarely subject to spontaneous combustion. In bituminous coal spontaneous combusion is due primarily to the generation of heat through slow oxidation of the carbon, accompanied by conditions of storage which prevent the heat generated from being dissipated rapidly enough to keep the temperature of the coal below the ignition point. As air is necessary to support oxidation, spontaneous combustion will be prevented if air is excluded from the coal. For a discussion of this subject reference is made to Technical Paper 235 of the U. S. Bureau of Mines.

In open air storage, subdividing the piles with concrete walls will assure that fire resulting from spontaneous combustion will be confined to a given area, and will facilitate loading out the coal affected so that the fire may be extinguished.

In addition to making spontaneous combustion impossible, under-water storage is most effective in preventing any appreciable loss of heat value through gradual oxidization. Pits for submerged coal storage should be concrete lined to prevent loss of water and coal.

Grades of coal having different degrees of tendency toward spontaneous combustion should not be piled together in open storage. When placing coal in storage, care should be taken to prevent any considerable separation of lumps and fine material, as an accumulation of fine coal at one spot in storage contributes to the possibility of spontaneous combustion. Mine-run coal, therefore, should be placed in storage in layers and uniformly distributed. These precautions are unnecessary, however, with submerged storage.

Pieces of oily waste, wood and other combustible material should be kept out of large open air piles of stored coal.

Coal stored in tight elevated bins may readily be flooded in case spontaneous combustion threatens. In fact, bins may be divided into compartments when built, so that in case of spontaneous combustion not all of the coal stored will be in danger.

### Conclusions.

It is evident that coal in storage provides insurance against reduced output, or enforced shut-down of an industrial plant due to inability to get from day to day necessary coal for operation. Stored coal, therefore, is the balance wheel which equalizes supply of such fuel for power purposes.

Facilities for storing coal place the purchaser in the desirable position of giving the seller opportunity to arrange for delivery at his convenience, which in general is also of advantage to the purchaser.

All classes of coal, particularly the low grades, which in open storage may suffer loss of heating value or be particularly subject to spontaneous combustion, can be safely stored in concrete pits where the fuel can be submerged as required.

When elevated storage is arranged for by concrete bins, danger of fire from external storage is removed. Concrete structures are also free from depreciation and require little or no maintenance.

Concrete walls divide the storage pile and concrete paving on the ground area provide the next best insurance against spontaneous combustion to concrete lined pits and tight concrete elevated bins. Concrete pavement over the storage area greatly facilitates reclaiming the coal and prevents inclusion of dirt while reclaiming.

Concrete driveways throughout the open air storage areas will facilitate movement if the coal is handled by team or truck.

Neither the firing nor any other quality of coal is injuriously affected by storage.

Storage of coal affects in a beneficial way both its production and transportation. Industry is bound to benefit by anything that will increase available transportation facilities. The good effect of stabilizing coal production so as to allow a proper average output throughout twelve months insteading of crowding the major portion of that output within a seven or eight-months' period is usually reflected in more satisfactory contract prices.

# Efficiency in Hand Shovelling

## Some Hints of Practical Value to Contractors as to the Methods of Improving the Output of Their Labor Forces—The Proper Use of the Shovel—Effect of Rest Periods

By B. G. Best in "Engineering and Contracting"

The foundation of efficient shoveling is the intelligent direction of human energy. A man possesses a certain amount of energy which he can use each day without injury to himself. The amount varies, of course, with different men. Some, on account of superior strength and endurance, can expend more than the average amount of energy, while others of a weaker constitution, can not put forth as much as the average. Men of the latter class should not be used where efficient and economic shoveling is desired, but should be transferred to other work which they are physically able to perform in an efficient manner, for if they are employed as shovellers at the same rate of pay as efficient workmen, not only are the shoveling costs increased and the tons per man—or any other measure of efficiency—decreased, but there is also a tendency for a spirit of discontent to grow among the workmen. The first step, then, in securing economic results, is the elimination of those men who are physically unfit and the selection of men who are capable of performing the amount of work required of efficient shovellers.

### Methods of Increasing Shovelling Output.

Having selected men of the proper type the next step is to provide an incentive which will create in the men a desire for increased production. Working for wages the average man will do just as much work as is necessary to hold his job. A driving boss will increase the amount of work done, but the results will not be satisfactory because the men are working because they have to, and not because they have any desire to do a good day's work. When a number of men are working in widely separated places, the results of driving are even less satisfactory. Another method of speeding up the work is to so proportion the size of the shovel gang and the capacity of the wagons, carts or cars used that not more than five minutes will be required for the gang, working steadily, to fill the wagon, and to run the wagons on such a schedule that short resting period, but no loafing time, will be allowed between trips. A more satisfactory method is the use of a bonus or contract system of payment, properly devised and properly used. With such a system each man has a personal interest in the work and knows that the amount earned depends only on the amount of material moved.

### Good Working Place Important.

No matter how willing he may be, a man cannot achieve the best results in a poor working place, for if he is using part of his available energy to combat the effects of poor ventilation, dust, heat, high humidity powder smoke or gas, he has that much less energy to use in his work. Proper ventilation is an all important factor, especially in mining. Considerable inconvenience and discomfort is caused in many metal mines by the high temperature caused by the high temperature caused by the oxidation of timber, and by the high relative humidity of the air. Even hot, humid places may be made comfortable, however, if sufficient velocity is imparted to the air. If a man must work in a place filled with powder smoke or gas the ill effects will not disappear with the smoke or gas, but will reduce his efficiency for the greater part of the shift, or even longer. A cramped working place has the same effect as emery dust in the bearings of an engine. To do good work a man should have at least 2½ ft of space, measured along the edge of the pile.

### Nature of Material and Shoveling Speed.

The nature of the material bears an important relation to the ease and rapidity with which it is handled. To take an efficient shovelful of very light material requires a shovel so large that in a confined working space it will be clumsy and akward. Heavy, wet, and sticky materials, such as clay, are hard to load and. stick to the blade of the shovel in unloading Sand or other fine materials can be shovelled easily from any part of the pile, but a pile if hard, chunky ore must be shovelled from the bottom, and even when steel plates are used it is sometimes difficult to handle this kind of material. A slghtly moist, or fine material, or a dry hard dry material such as wheat or corn. The weight of the material, its consistency, and the size of the fragments or particles must be considered in estimating the cost or speed of shovelling.

### Size and Shape of Shovel.

In handling any kind of material the most effective work is done with a shovel which holds a load of 21 lb. The efficiency and advantages of using such a shovel are questioned no longer. Although a shovel holding less tran 21 lb. will permit the handling of a greater number of shovelfuls per minute than will a 21-lb. shovel, the amount of material handled will be approximately proportionate to the capacity of the shovels. A No. 2 shovel will carry a load of not more than 15 lb. of ordinary earth. Therefore 21 loads with a No. 2 shovel will be required to move the same amount of earth that would be moved in 15 loads with a 21-lb shovel. In other words the efficiency of a No. 2 shovel in handling ordinary earth is about 70 per cent. The same shovel, however, will be 100 per cent efficient in handling a fine, heavy ore. It is rtodily seen that the weight of material to be handled will determine the size of the most efficient shovel. Depending also upon the nature of the material is the shape of the shovel. The lateral curvature, or curl of the blade helps to keep the load on the shovel. While a shovel having a blade of cruicible steel or special shovel steel will cost more than one with a stamped sheet steel blade, the superior wearing qualities of the first type will be well worth the additional cost. A one-piece blade is preferable to one of two or more pieces. Another important factor in choosing a shovel is the lift, or vertical distance, when the blade of the shovel is flat on the floor, from the floor to the end of the handle. A small lift necessitates too much bending and too great a lift increases the difficulty of pushing the shovel into the pile. With D-handle shovels lifts as high as 24 in. have been used with satisfactory results. Because less work is required in both loading and lifting, 7½ to 10 per cent more material can be moved with a long-handled shovel than with the short or D-handle, tool.

Placing a shovel of proper size, shape, and construction in the hand of a strong and willing worker does not make an efficient shoveler. The fact that it is not generally recognized that many men do not know how to use a shovel in the most efficient manner. However an investigation will show that some men, with no greater effort than others, can handle 25 or 30 per cent. more material simply because they know how to shovel. The proper way for a right-handed man to use a shovel is described below. Holding the handle D in the left hand and with the right grasping the handle 15 or 18 in. from the end,take a position near the pile and facing it, with the right foot pointing ahead and the left about 18 in behind the right and pointing outward. Now, resting the right forearm on the right leg just above the knee and holding the shovel handle on the right leg, crouch forward, bending the knees and back, and push the shovel into or under the pile, bringing the left inside of the left leg, and using the weight of the body and the thrust ot the knees and left leg to help the arms. If shoveling into a low ca. near the pile straighten the knees and partially straighten the back, turning the body slightly to the right, and cast the load over the shoulder. In using the long-handled shovel stand with the right side toward the pile. Hold the shovel with the left hand about 6 in. from the end of the handle and the right 2½ or 3 ft. lower. Resting the right forearm on the right leg as before force the shovel into the pile with a side thrust of the body. Straighten the knees and back, and cast.

### Advantages of the Shoveling Platform.

Any except fine material should be shoveled from the bottom of the pile, not only because the shovel can be forced under the pile more easily than under it, but because in shoveling from the bottom the upper part of pile becomes loosened and rolls down where it can be handled easily and quickly. With most materials difficulty will be encountered in pushing the shovel even under the bottom of the pile unless a shoveling platform is used. In its simplest form a shovelling platform is a layer of 1-in. thick boards laid on the ground and on which the material is thrown or dumped. When New, such a platform will decrease the actual shoveling time from 5 to 20 per cent. In time, however, the boards wll crack, splinter, and warp, and the saving in shoveling time will be lessened. A platform of steel plates will last indefinately and will increase the shoveling efficiency from 10 to 30 per cent. When it is impracticable to use a large platform of sheet steel small individual plates can be used to advantage. In cleaning up the remnants of a large pile of soft coal which had been dumped on a plank platform, shovelers averaged 11 shovel loads per minute. By using a number of steel plates, 2½ or 3 ft. square, placed along the edge of the pile, the number of loads per minute was increased to 1.

### Effect of Height in Shoveling Speed

Also affecting the shoveling speed is the height to which the material must be lifted. To obtain the maximum efficiency the height of the car or cart intó which the material is being loaded should not exceed 30 to 33 in. Increasing the height 12 in. will reduce the amount of material handled by approximately 2 per cent, and increasing the height by 2 ft. will cause a reduction of efficiency from 7½ to 10 per cent. Each additional 6-in. increase will be accompanied by a corresponding 7½ to 10 per cent. reduction, until a height of 6 or 8 ft. is reached. For heights greater than these, which are the maximum heights to which material can be lifted efficiently with long-handled shovels, respectively, staging should be used and the material rehandled.

The amount of material handled is influenced to some extent by the distance from the material pile to the wagon or car. The best results are obtained when this distance is between 3½ and 4½ ft.

### Effect of Rest Periods on production.

Recent investigations in different industries have shown that when workers are given rest periods at regular predetermined intervals they will produce more and at a uniform rate, than when they choose their own rest periods. In one instance the introduction of rest periods aggregating 25 per cent of the total time resulted in a 30 per cent increase in production. These investigations have demonstrated that resting time has a definite influence on the size and rate of production and is as important as working time. Under ordinary conditions a man whose work consists entirely of shoveling will spend from one-third to one half of his time resting, and even under the most favorable conditions a man can not spend more than 70 or 80 per cent of his time in actual shoveling. This does not mean, however, that the best results will be obtained when a man spends 20 or 30 per cent of his time doing nothing.

Alternating shoveling with other operations, such as picking or tramming, will reduce the period of idleness and at the same time afford a rest from the hard work of shoveling. In tunnel work for instance, it is not uncommon to have three gangs of shovelers, or muckers in one working place. While Gangs 1 and 2 are loading a car Gang 3 removes the car which has just been filled, returns to the face with an empty car, and picks down the pile for the other gangs. When the car has been filled it is removed by Gang 3. In this way each man spends two thirds of his time shoveling and the remainder in tramming picking and resting.

### Contract System in Iron Mines in Lake Superior District.

In the underground iron mines of the Lake Superior district it is customary for the miners to work by contract, drilling, blasting, mucking, tramming and timbering, for which they receive a specified price per ton for ore removed or per foot of advance. Two good men will shovel 2,600 lb. of fine ore into a car 3 ft. 8 in. high in about five minutes. Two or three minutes will usually be sufficient time to tram to the nearest raise, dump and return with the empty car, and after resting a few moments the men are ready to load another car. Working in this way a man spends from one-half to two-thirds of his time in shoveling and about the same proportion of the remaining time in tramming. Cars of different sizes have been used, and although the smaller cars are easier to load and can be used in smaller places, the best results have been obtained with a sub-level car having a capacity of at least a ton of broken ore. In addition to the increased amount of tramming time made necessary by the use of smaller cars, there is a psychological effect on the men which should not be overlooked. Loading a car regardless of its capacity is a task to be completed, and a man will subconsciously try to complete that task in one operation and will relax when that operation is finished. In other words he derives just as much satisfaction from filling a ½-ton car as he does from loading a car of twice that size and will probably take the same amount of rest in either case. Loading two ½-ton cars, therefore, requires the same amount of muscular energy but twice as much mental energy as is required to fill one car holding a ton. Furthermore, under a contract system an additional small car at the end of the shift may mean only 15 ct. more pay, which is almost negligible, but a extra car of the large size will represent an additional 30 ct., which is worth working for.

### Requirements for Economic Shoveling.

Summarized, the three requirements for economic and efficient shoveling are:

1. The selection of men who possess an adequate supply of human energy.

2. The creation, among the men, of a desire for greater production and a willingness to expend their energy in the performance of useful work.

3. The use of tools, appliances, and methods best suited to the material to be handled in order to obtain the highest results from the energy expended.

In fulfilling these requirements the following factors must be considered, all of which will affect the speed and cost of shoveling.

TABLE I.

| Case. | Height of wagon or car<br>2ft. 6in. | 4ft. 6in. | 5ft. 0in. | 5ft. 6in. | 6ft 0in |
|---|---|---|---|---|---|
| I—Loads per minute | 7.00 | 6.37 | 5.72 | 5.08 | 4.45 |
| Pounds per minute | 119 | 108 | 97 | 86 | 75 |
| II—Loads per minute | 8.00 | 7.27 | 6.55 | 5.82 | 5.09 |
| Pounds per minute | 136 | 123 | 111 | 99 | [illegible] |
| III—Loads per minute | 10.00 | 9.10 | 8.17 | 7.26 | 6.35 |
| Pounds per minute | 170 | 154 | 139 | 123 | 108 |
| IV—Loads per minute | 11.00 | 10.00 | 9.00 | 8.00 | 7.00 |
| Seconds per load | 5.45 | 6.00 | 6.67 | 7.50 | 8.58 |
| Seconds pushing | 3.45 | 3.45 | 3.45 | 3.45 | 3.45 |
| Seconds lifting | 2.00 | 2.55 | 3.22 | 4.05 | 5.13 |
| Pounds per minute | 187 | 170 | 153 | 136 | 119 |
| V—Loads per minute | 10.10 | 9.23 | 8.37 | 7.50 | 6.70 |
| Seconds per load | 5.95 | 6.50 | 7.17 | 8.00 | 9.08 |
| Seconds pushing | 3.95 | 3.95 | 3.95 | 3.95 | 3.95 |
| Seconds lifting | 2.00 | 2.55 | 3.22 | 4.05 | 5.13 |
| Pounds per minute | 212 | 194 | 176 | 157 | 139 |
| VI—Loads per minute | 12.10 | 10.90 | 9.73 | 8.57 | 7.42 |
| Seconds per load | 4.95 | 5.50 | 6.17 | 7.00 | 8.08 |
| Seconds pushing | 2.95 | 2.95 | 2.95 | 2.95 | 2.95 |
| Seconds lifting | 2.00 | 2.55 | 3.22 | 4.05 | 5.13 |
| Pounds per minute | 254 | 229 | 204 | 180 | 156 |
| VII—Loads per minute | 13.45 | 12.00 | 10.60 | 9.23 | 7.92 |
| Seconds per load | 4.45 | 5.00 | 5.67 | 6.50 | 7.58 |
| Seconds pushing | 2.45 | 2.45 | 2.45 | 2.45 | 2.45 |
| Seconds lifting | 2.00 | 2.55 | 3.22 | 4.05 | 5.13 |
| Pounds per minute | 283 | 252 | 222 | 194 | 166 |
| VIII—Loads per minute | 15.50 | 13.30 | 12.00 | 10.43 | 9.12 |
| Seconds per load | 3.95 | 4.50 | 5.00 | 5.75 | 6.58 |
| Seconds pushing | 2.20 | 2.20 | 2.20 | 2.20 | 2.20 |
| Seconds lifting | 1.75 | 2.30 | 2.80 | 3.55 | 4.38 |
| Pounds per minute | 319 | 280 | 252 | 219 | 192 |

TABLE II—RELATIVE EFFICIENCY.

| | Height of wagon or car<br>2ft 6in | 4ft. 6in | 5ft. 0in. | 5ft. 6in. | 6ft. 0in. |
|---|---|---|---|---|---|
| Case I | 37.3 | 33.8 | 30.4 | 27.0 | 23.7 |
| Case II | 42.6 | 38.7 | 34.8 | 31.0 | 27.0 |
| Case III | 53.2 | 48.4 | 43.5 | 38.5 | 33.8 |
| Case IV | 58.7 | 53.3 | 48.0 | 42.7 | 37.3 |
| Case V | 66.5 | 60.8 | 55.2 | 49.25 | 43.6 |
| Case VI | 79.7 | 71.8 | 64.0 | 56.4 | 48.9 |
| Case VII | 88.75 | 79.0 | 69.7 | 60.8 | 52.1 |
| Case VIII | 100.00 | 87.8 | 79.0 | 68.7 | 60.2 |

1. The man—his physical and mental condition.
2. The method of superintendence and payment.
3. The condition of the working place.
4. The nature of the material to be handled.
5. The shovel—its size, shape, and construction.
6. The method of shoveling.
7. The surface from which the material is shoveled.
8. The height to which the material must be lifted.
9. The horizontal distance which the material is thrown.
10. The proportion of time which is spent in shoveling, other operations and resting.

### Comparison of Effects of Various Factors in Speed of Shoveling.

The effects of these various factors are illustrated by the following example, which, obviously, is of little value except for purposes of comparison. The man is of average strength and intelligence, and knows the correct method of using the shovel. The material is broken rock, the pieces being of various sizes and irregular shapes. In Case 1 the man is working for wages, in a hot, stuffy working place, and does nothing but shovel. Under such conditions he will throw seven shovelfuls of rock per minute into a car 2½ ft. high supposing that the material is of such a weight that a No. 2 shovel will hold 17 lb., in one minute the man will handle 119 lb. of material. For other heights of car the number of loads per minute and the pounds per minute are shown in Table 1. In Case 2 the man loads his car, and returns to his working place. In doing this he rests the musles which have been used in shoveling and possibly gets a breath of cooler air. Consequently he can increase his shoveling speed to the figure shown in Table 1. In Case 3. the man is working by contract instead of for wages. He has an interest in his work and realizing that he will be paid for what he does, he will increase his efforts with the results shown. If the man is now transferred to a good, roomy working place, with plenty of fresh air, he will be able with the same amount of energy to accomplish the results shown for Case 4. In this and in the succeeding cases is shown the time in seconds required to push the shovel into or under the pile, as well as the time to lift the loaded shovel to the top of the car, discharge the load, and lean over preparatory to pushing the shovel into the pile for a second time. It will be noticed in Case 4 that the pushing time remains constant at 3.45 seconds for all heights of cars, and that the lifting time increases with the height of car. Replacing the 17-lb. shovel with one taking load of 21 lb., Case V, will possibly increase the loading time by ½ second, but will also increase the amount of material handled. In all of the preceding cases the man has been shoveling material that has been dumped or thrown on the uneven ground or the irregular floor of a tunnel, but in Case 6 the material has been thrown on a board platform, which decreases the pushing time by one second, with a corresponding increase in the number of loads per minute. If a steel platform is used, Case 7, the shoveling speed will be still further increased. Using a long-handled shovel will decrease both the pushing and the lifting time, with the results shown in Case 8.

Considering the highest output—319 lb. per minute—to be 100 per cent, the various efficiencies under the different conditions are shown in Table 2.

Although the recent development of mechanical leaders has been rapid, hand shoveling still is, and for some time will continue to be, an important factor in both construction and mining operations, and for this reason time and money spent in raising the efficiency of shoveling will be well repaid in decreased costs and increased production.

# Alkali Corroded Steel Water Main Protected by Concrete

The Dominguez Water Co., near Los Angeles, Cal., has made successful use of reinforced concrete jacketing as a protection to steel pipe badly corroded in strong alkaline soil. After experimenting with various liquid protective coating, which proved unsatisfactory, it was noted the leaks repaired by plugging the light steel pipe with redwood and covered with a rich cement concrete band, were well preserved even after several years. This experience suggested a reinforced concrete casing on extensive pipe lines. Mr. G. H. Hand describes the work in a recent issue of "Concrete."

The Rancho San Pedro, or Dominguez Ranch, as it is known locally, consists of a tract of land some 17,000 acres in extent. In general, the surface of the land is comparatively flat, with the exception of some 1,500 acres comprising what is known as Dominguez Hill, which rises along an elevation of 195 ft. above sea level. The soils vary in character from a sandy loam to a heavy adobe, the latter containing alkaline salts in various degrees.

To supply an adequate amount of irrigation water for this tract of land, the owners of the Rancho in 1921 laid out a very comprehensive system of piping and constructed a pumping station with a daily capacity of 16,000,000 gals. Water for this station was developed from six casing wells, each 12 in. in diameter and averaging about 1,000 feet in depth. This water, which is exceptionally pure and soft, is brought to the surface by compressed air and is discharged into a large settling basin, where any sand carried up from the water bearing strata is dropped before the water is taken up by the pumps and passed through the mains.

The entire piping system is divided into three units each operating against a different head. The first unit consists of 40,646 ft. 33-in. diameter riveted steel force main, with laterals, and is constructed of No. 10 gauge material. This main passes through a stretch of river silt, then through a heavy adobe and finally through a light sandy soil free from corrosive salts. This line is crossed by three electric railway tracks, and tests show the presence of stray currents along the main. The working head on this main is 100 ft.

The second unit comprises 15,000 ft. of 20-in. diameter riveted steel force main, with laterals, constructed of No.10 gauge material and operating against a head of 207 ft. This main supplies the Dominguez section and turns north before encountering the heavy alkaline adobe through which N. I main passes. Little trouble has been had with this stretch of pipe.

The third unit consists of 15,600 ft. of 20-in. diameter riveted steel force main, with laterals, constructed of No. 14 gauge material and sustaining a head of 65 ft. This latter line, while it avoids the heavily alkaline adobe, nevertheless passes through some soil more or less spotted with alkaline salts and as it is constructed of light material has occasioned considerable trouble and a high maintenance cost.

Since the inception of the project the maintenance costs on all pipe passing through the "adobe belt" have been very high and in fact more than 23,000 ft. of 8-in. diameter steel riveted laterals, passing through what is known as the Nigger Slough section, have been totally destroyed.

Our 33-in. force main passes through this same locality and we were obliged to re-lay a 1,500-ft section which had become seriously pitted and corroded. However, it was apparent that it was only a question of a short time until the entire main passing through this alkaline section would be destroyed and the expedient of placing a protective shell of concrete around the threatened sections of the pipe was resorted to. A section of badly corroded pipe was selected and the concrete shell placed about it as an experiment. This experimental covering was placed in 1918, and although this section had reported a countless succession of leaks prior to the time of concreting it, we have never had a leak in it since that time.

### Jacket of Concrete.

At this time about 6,500 ft. of 33-in. diameter main has been covered with a jacket consisting of a 2-in. shell of concrete, reinforced with heavy wire. In placing this jacket a steel form is used, consisting of two semi-circular plates which are bolted tightly together at the bottom, but leave a gap of about 4 in. across the top, through which the concrete is poured. The ends of the form are closed by a circle of 2-in. rope placed between the pipe and the form. This provides not only a tight end joint, but insures a uniform spacing of the forms which are made up in 4-ft. sections.

Before placing the concrete, the pipe is carefully scraped down and cleaned with steel brushes, all small leaks are plugged with redwood plugs, and a thin wash of neat cement is applied. The reinforcing is then placed, the latter consisting of circumferential rings of two-strand No. 10 gauge twisted wire, spaced at 4-in. intervals. The steel forms are then placed and the concrete poured, the latter consisting of a 1:1 mix of cement and coarse sand. The forms are removed 36 hours later, and small piers of 1:3:6 concrete are placed under the pipe at 15-ft. intervals to support it while the next section of supporting earth is removed and the operation repeated. While the forms remain in place the same force of men is digging out another section and preparing the pipe for the application of the concrete. After the removal of the forms the concrete is wet down daily and seasoned thoroughly before the trench is back-filled and the pipe covered. To date we have had only two instances of leaks in sections where this concrete shell had been applied. Both of these were due to weather cracks, which were undetected before backfilling the trench.

Following are data on cost of this work for 1918.

Volume per lin. ft. = .056 cu. yds.

Per 100 ft. section = 5.63 cu. yds.

Cost cement = $2.15 per bbl. net.

Cost sand = $1.00 per yd.

Proportion of mix, 1:1; 38% voids.

Cement=1bbl. = 3.80 cu. ft., at 2.15 per bbl. = .556 per cu. ft.

Sand—1 cu. yd. =27 cu. ft., at 1.00 per yd. = .037 per cu. ft.

Reinforcing wire at $5.00 per 100 lbs. = .05 per 1 lb.

Spacing in reinforcing wire = 4in. or .30 lin. ft. wire per lin. ft. of concrete, allowing 18 in. per wrap for kinks and lap. Cost of wire per ft. = .00455.

Cost per 30 ft. equivanent to 1 ft. of concrete = .1365.

Costs of Material per 100 ft. section.

| | | |
|---|---|---|
| Cement, 104.4 cu. ft., at .566 | | $59.09 |
| Sand, 106.4 cu. ft. at .37 | | 3.94 |
| Wire, 3,000 ft. (285 lbs.), at .00455 | | 13.65 |
| Piers. | | |
| 3.5 cu. per pier. | | |
| 6½ piers per 100 ft. length. | | |
| Mixture—1:3:6. | | |
| .842 cu. yds. concrete per 100 ft. | | |
| Cement, .9262 bbls. | $2.00 | |
| Sand, .3863 cu. yds. | .387 | |
| Gravel, .7830 cu. yds. | .783 | 3.17 |
| Total cost material | | $79.85 |

Labor Placing Concrete

| | |
|---|---|
| 6 men, at $2.25 per day | $13.50 |
| 1 man, at $3.33 per day | 3.33 |
| 1 team, at $1.00 per day | 1.00 |
| Total | $17.83 |

This force would place an average of 45 lin. ft. per day including piers.

Coct per ft. on above basis = .396.

Cost per 100 ft. above basis = $39.60.

Labor—Trenching and Backfill.

Same force as above, $17.83.

A combined trench and backfill averaging 19.6 ft. per day was completed by the force.

| | |
|---|---|
| Cost per ft. on above basis | $ .905 |
| Cost per 100 ft. above basis | $ 90.55 |

Recapitulation.

| | |
|---|---|
| 100 foot lengths— | |
| Material | $ 79.85 |
| Labor | 39.60 |
| Trench and fill | 90.55 |
| | $210.00 |
| Total cost per foot = | $ 2.10 |

Experience has demonstrated that for the protection of large diameter pipes this method has been very satisfactory, as it has practically eliminated a heavy maintenance charge in a section where conditions were very unfavorable, at a very much lower figure than that of replacement with new pipe, which in turn would have in a comparatively short time deteriorated to the same extent as the first installation.

The labor charge is practically as great in the case of small pipes as in respect to larger diameters, making the operation unprofitable, so that we are not attempting any extensive work of this character with out laterals, which are in 8-in. and 10-in. diameters, but are replacing the steel lines with wire-bound redwood stave pipe which have given eminently satisfactory service in the alkaline soils here on the Rancho.

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For many years the Brown Hoisting Machinery Co. has been building buckets ranging in capacity up to 15 or 20 tons for loading machinery, bridge cranes, etc. This experience has now been made use of in producing a clamshell bucket which is a worthy addition to the present line of buckets. This new clamshell is a powerful digger and has manganese steel digging edges which can be easily replaced when worn. One of its strong features is that it has few parts, which are easily accessible, and if repairs become necessary they can be made right on the job. Bronze bushings are used and, throughout, the bucket is designed to reduce wear to a minimum. They are made in 3/4 yard, 1 yard, 1½ yard and 2 yard sizes. A leaflet describing these buckets has been prepared and will be furnished to any of our readers who may be interested.

# Power Situation in the Province of Quebec

By R. J. BEAUMONT

In a brief survey of the electric power developments and possibilities of the Province of Quebec two outstanding features are to be observed, the most important of which is the amount of water-power that yet remains to be utilized for this purpose, and of secondary importance the rapid developments of water-power for electrical generating purposes during the last twenty years.

There are throughout the Province a number of small water-powers that have been used for supplying mechanical power for a great many years which were in use before electric light was commercialized, this latter form being the first practical use of electrical energy. These powers were and some are still used for operating pulp and paper mills, saw mills, grist mills and for such similar purposes.

One of the most important early examples of the application of water-power for electrical purposes in Canada was the development of the falls at St. Narcisse on the Batiscan River. A plant of a little more than 1,000 horsepower was built and the power conveyed to Three Rivers, a distance of about 16 miles. An interesting feature of this little plant is that it was the first used to generate power for high tension transmission in the British Empire, electric power being delivered over the transmission line at 11,000 volts in 1895. It is a very small undertaking when considering voltages, amounts of power and distances dealt with successfully to-day.

We will consider in a few words the growth of development around Montreal during the past twenty years. The first plant of importance may be said to be the Lachine plant. This plant has been in operation since 1898 and has a capacity of approximately 15,000 h.p.

Simultaneously with the construction of this plant there was put into operation the Chambly plant with a somewhat larger capacity. The Soulanges plant on the Soulanges Canal just below the Cedar Rapids plant was completed in 1908.

In addition to these plants which were constructed to supply the demand of the city of Montreal for power, the year 1903 saw the putting into operation of a generating plant at Shawinigan Falls and the transmission of power to Montreal. At that time the proposal to send power in from Shawinigan to Montreal, a distance of 100 miles, was considered a very speculative scheme by many people and the experiment was watched with great interest.

After the completion of the first wood pole line to Montreal another similar line was soon undertaken and owing to the continued demand in Montreal the year 1911 saw the completion of a double circuit steel tower line supplying power at 100,000 volts, making four lines in all between Shawinigan Falls and Montreal. There is in addition another double circuit steel line in course of construction.

In 1911 a plant at St. Timothee was put into operation, this plant taking power from the Beauharnois Canal with a transmission line to Montreal, the capacity of this plant being approximately 30,000 h.p.

The next large development after the development at Shawinigan Falls, and one which represented a definite progressive step in hydro-electric engineering development, in so far as this country is concerned, was the construction of the Cedars Rapids plant. This plant was a large engineering undertaking. It is a low head plant with 12 vertical type units of approxiately 11,000 h.p. each. The final development provides for 18 such units. This plant supplies power to Montreal and also power to Massena where it is used for industrial purposes.

The latest large plant to be put into operation for the purpose of providing power for Montreal and vicinity is the plant at Grand Mere. This plant has a capacity of about 120,000 h.p.

It will be seen from the foregoing that the development has been rapid. In the same manner to perhaps a lesser degree, a similar development has occurred in Quebec City but space is too limited to deal with the subject at length. During the same period throughout the Province of Quebec there has been constructed a large number of small plants for electric power purposes. We might instance St. Anne de Beaupre, Sherbrooke, Drummondville and many others.

Undoubtedly a practically inexhaustible source of electrial power has been of the greatest value in developing the Province in the past few years and will continue to do so for many years to come. Considering this effect in Montreal we see a city using a tremendous amount of electric power, each year seeing a rapid increase in demand over previous years, and we may instance as indicative of this growth the load on the plants at Shawinigan Falls.

In 1905 the load was 20,000 h.p.; in 1910--50,000 h.p, in 1920--220,000 h.p. The effect on certain industries is to be easily seen. For example, in the asbestos mining industry the presence of the asbestos and the availability of electric power has made Quebec the foremost producer in the world. Again, in the paper industry a tremendous amount of power is used and the last few years have seen an almost incredible increase in the production of paper and in the amount of power used for this purpose.

Parallel with the work of construction of systems to fill the needs of the larger cities there has proceeded the building of a network of transmission lines to serve the smaller towns and villages. This network extends on the north shore of the St. Lawrence River west from Quebec City to and beyond Montreal and in a somewhat similar way on the south shore. This work of connecting up the smaller communities is continually going forward, though the smallness of the communities and the distance of their location from the main transmission line often makes the matter of giving them service a difficult problem from the financial viewpoint, and the serving of some of the more distant scattered farming communities is a problem yet to be dealt with.

The cost of electric power compares to advantage with Ontario considering the expensive developments at Niagara Falls. Also, in Ontario compared with the Province of Quebec, where private undertakings are the rule, is the fact that the public ownership of the electrical properties takes away for taxation purposes a large source of revenue to the Province.

The Hydro-electric developments in the different parts of the Province have been exceedingly favored by nature with regard to the fact that they lend themselves to the easy utilization of the power at minimum cost, Shawinigan Falls itself perhaps being the best example of such a condition to be found anywhere in the world.

*Right:*
Ouaitchouan
Falls,
Lake
St. John,
Quebec.

*Left:*
Metis Falls,
Metis River,
Matane,
Quebec.

## Mainly Constructional

**East and West—From Coast to Coast**

Winnipeg announces that no further housing loans will be available this year, as all the funds have been disposed of. During the year 219 loans were approved and $899,000 loaned.

A disastrous fire which occurred at Annapolis Royal, N. S., a few day's ago, caused damage amounting to about $250,000. Total insurance carried in the destroyed area totalled about $125,000.

About fifty workmen's dwellings, of the bungalow type, are being erected at the present time in Silverthorn district, Toronto. The community spirit prevails, the builders taking turns in helping one another.

The Canadian Gary Motor Trucks Corporation will establish a plant at Fort William, Ont., to supply the Western Canada demand. This is a new subsidary company of the American firm and will be capitalized at $4,500,000.

An early start is anticipated on the municipal bridge over the C. P. R. tracks at Hochelaga, P. Q. Plans for the structure, which will cost about $250,000, are ready and everything is in readiness to go ahead with the calling of tenders.

Messrs. Dodge Bros., of Detroit, have purchased a 35-acre tract of land at Sandwich, Ont., with 350 ft. water frontage, and it is rumored they are contemplating the erection of a large assembling plant on the site. The purchase price of the land was $287,000.

The associated Boads of Trade of Temiskaming District, Ont., met recently at Haileybury and prepared a memorandum for presentation to the Provincial Government, asking for a yearly expenditure of $2,250,000 on good roads in the northern part of the province.

The moveable plant of the Sir John Jackson Company, Limited, the large English construction firm, which recently closed up its Canadian branch at ictoria, B. C., will be shipped to England on the company's ship "Mafalfa" which arrived at Victoria about the end of last month.

Count D'Armand, chairman of the "France Au Canada" train, which visited the Toronto Exhibition, assured the Exhibition authorities before departing from the city, that he would recommend to the French Government the erection of a permanent building at the Exhibition grounds, for the display of products of France.

The Board of Education at London, Ont., has authorized its architects to go ahead with the preparation of plans for a sixteen-room collegiate institute. Plans will be prepared in such a way as to provide for the erection of an eight-room structure at the present, allowing for the addition of eight more rooms when required in the future.

It has been announced that a conference of city engineers, town planning experts and architects will be held at Montreal on September 29 and 30 and October 1, at the Place Viger Hotel. This conference is the outcome of a growing realization that Montreal needs a comprehensive town planning development scheme to keep pace with its industrial growth.

A building concern at Toronto, Superior Homes,Ltd., has offered to finance the building of streets through the district in which they are building their houses, this money to be paid back by the city within a specified time, at the usual rate of interest. This offer is made in view of the fact that in 1921 appropriation for this purpose has already been spent by the city.

The School authorities at Toronto have authorized the use of enamelled brick in the construction of basement walls in several of the new schools and additions Though this type of construction is dearer in first cost, it is believed this difference will be made up in maintenance expense, besides giving a more attractive and sanitary wall, also one more easily kept clean.

The city of Halifax got a bad scare recently when five of the battery stills at the Imperial Oil Company's plant in that city exploded early one morning. The explosions could be heard for a long distance and brought thousands of citizens out of their beds, fearing a repitition of the 1917 disaster. The fire was soon brought under control, however, and no casualties resulted. The stills were five of a battery of twelve installed last year at a cost of $1,000,000.

### Personal

Sir Robert Borden was recently elected to the Board of Directors of the British American Nickel Corporation.

Messrs. Banigan, Armstrong & Thompson Ltd., architects of Toronto, have changed their name to N.A. Armstrong Co. Ltd, and will continue to carry on their business with the same organization as formerly at 7 King St. E.

Mr. H. C. McMordie, until recently associated with the Trussed Concrete Steel Company, has opened an office in the Bartlet Building, Windsor, Ont., where he will carry on the business of consulting engineer. Mr. McMordie for the past nine years has been connected with the above mentioned firm, during the last two years of which period he occupied the position of chief engineer. Previous to that he had been connected, in an engineering capacity, with the Canadian Bridge Co. and before that had occupied the position of municipal engineer at North Battleford, Sask. Mr. McMordie is an associate member of the Engineering Institute of Canada.

Following is a list of the officers elected at the recent annual convention of the British Columbia Good Roads League: Hon. president, W. A. MacKenxie, Penticton; president, Mayor R. H. Gale, Vancouver, B. C.; secretary, H. F. Bird, Vancouver; treasurer, J. W. Cunningham, New Westminster; 1st vice-president, Mayor J. J. Johnston, New Westminster; 2nd vice-president, Noble Binns, Trail; 3rd vice-president, Ald. J. R. Colley, Kamloops; 4th vice-president, Mayor H. B. Rochester, Prince Rupert. Directors: Reeve D. W. Poppy, Langley; J. R. Agar, New Westminster; Mayor T. Pitts, Duncan; Reeve G. Watson, Sannich; Mayor C. F. Costerton Vernon; J. W. Jones, Kelowna; Mr. Waterman, Princeton; Mayor C. F. McHardy, Nelson; Ald. Frank Woodside and Ald. F. Croone, Vancouver; Reeve E. H. Bridgeman, North Vancouver; J. H. Schofield, Trail; J. McLeod, Rossland; W. H. Wilson, Cranbrook; E. Henniger, Grand Forks; F. Lorne Roe, Penticton, and H. J. Perry, Prince George

### Trade Incorporations

Montreal Wire Works, Ltd., with head office at Montreal, capital $20,000, to manufacture articles of wire.

The Canadian Construction Co., Ltd., with head office at Montreal, capital $299,000, to carry on the business of general contractors.

The Three Rivers Construction Company, with head office at Three Rivers, P. Q., capital $49,000, to manufacture and deal in brick, tile, cement, plaster, stone, etc.

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## *Road Work Hampered by Lack of Co-ordination*

Now that the road construction season is drawing to a close, one may be permitted, perhaps, to do a little moralizing, drawing attention in so doing, to some defects in the systems of many contractors that, readjusted, will redound to an improvement in working efficiency and to an increase in profits. An examination of information gathered from road jobs in various parts of the country shows a very wide variation in the outputs of different organizations. Of course, this is to be expected in the case of operations that are carried out in widely separated localities and under very divergent conditions. However, even in contracts where conditions of material supply and methods of operation are similar, a study of the man-day output indicates a very marked difference in performance.

The surmise must be, since other factors are about equal, that differences in management are to blame for this condition, and in investigating further, it is found that the lost-time element, through lack of co-ordination of the outfit and the crew is mainly responsible for the poor character of many a contractor's work. Many organizations have operated through the season with negligible lost time, but many more have suffered from breakdown of equipment, failure of material supply or some other item that has caused a tremendous amount of time to be wasted and money to be spent without tangible results. The high overhead costs of a road contractor's organization permit a satisfactory profit to be made only if operations are continuous and uninterrupted. Such operation demands thorough co-ordination of the entire organization in its various details and a firm resolve to eliminate all needless shutdowns and lost time troubles.

Aside from stoppage dependent on shortage of the material supply, which is not always under the control of the contractor, the greater number of shut-downs are caused by breakdowns of equipment or its transfer from one part of the contract to another. It appears that many contractors have a very large percentage of lost time on account of equipment repairs while others with similar outfits work through a season with strikingly few breakdowns. This whole matter of keeping the mechanical plant in order and of having it where it is wanted when it is wanted is something that one contractor can do as well as another, if he just uses the same foresight and applies the same study to the problem. The attainment of success in road work is not necessarily with those contractors who appear to solve their problems with a large outfit and an involved organization, but is just as much assured to the contractor who operates in a small way, provided he is willing to give some attention to the proper co-ordination of his plant and crew.

## *Lower Wages Would Induce Greater Construction Activity*

Throughout the controversy on wages which has waged with more or less intensity at various points in Canada during the present summer, the labor representatives have consistently scouted the suggestion that a reduction in the wage scale would show its effect in an increased building activity. Unfortunately this argument, though entirely reasonable and logical, was impossible of definite proof except by actual test—which Labor has persistently refused to be a party to.

Definite evidence is now forthcoming, however, from the experience of the city of Chicago. The matter of wages in that city was made the subject of arbitration and following a decision of the arbitration board that wages should be reduced from 10 to 30 per cent., it is said that employment was forthcoming for between 40,000 and 50,000 workmen almost immediately. Chicago architects are reported as stating that $30,000,000 of new construction work will be put under way without further delay. There are a lot of people in Canada who have taken leave of their senses. To this class belong all those who will not work when there is work to be done—needing to be done badly— because the wage does not exactly suit them. Such a course is foolhardy from a personal, disloyal from a national, standpoint. The unemployed workmen of Canada to-day are largely, if not entirely, responsible for the condition they find themselves in. That the country as a whole suffers with them is not much consolation to anybody.

The fact is that "workmen" and "Labor" have become misonomers. "Work", as it was understood fifty years ago, or half of fifty, is shunned by a big percentage of our population, Men and women today are looking for ease and leisure. They are lazy, uninterested and uninteresting! The cities and towns are crowded with a population whose only expert knowledge lies in the best methods of evading work. They have lost the ideals of their fathers and mothers and never get beyond the stage, mentally, of childhood. Their so-called "work" hours are spent chiefly as a preparation for the period of recreation which is to follow, and the demand for shorter days is largely due to a dislike for work of any kind and a

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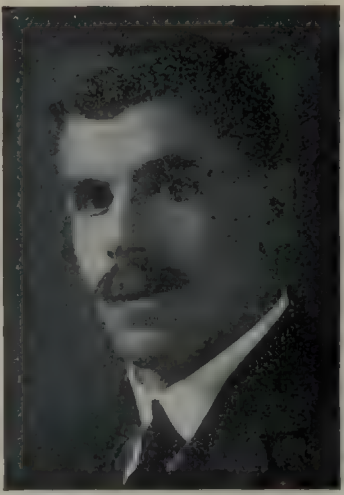
## *Canada's Engineers—F. P. Shearwood*



**Mr. Fredrick Perry Shearwood, recently appointed chief engineer of the Dominion Bridge Company, Limited, enjoys the distinction of having served continuously with that well-known organization for a third of a century. Born at London, England, in 1866, Mr. Shearwood was educated privately in England. He obtained his earliest engineering experience with the Sao Paulo Railway at Sao Paulo, Brazil, where he remained for three years, leaving Brazil for Canada in 1887, when he came to Montreal and secured an appointment with the engineering department of The Dominion Bridge Company, with whom he has remained ever since. It is hardly necessary to say that in the various positions he has held in the company's employ—from draughtsman to chief engineer—he has been identified with many constructional undertakings of outstanding importance and has thus accumulated varied and valuable experience which is an eminent qualification for the important post he now holds.**

**Mr. Shearwood is a member of the council of the Engineering Institute of Canada. He is also a member of the American Society of Civil Engineers and an associate member of the American Railway and Engineering Association.**

desire to get away from it. Higher wages are necessary to meet the demand of "unnecessaries"—things that grow in their appeal in proportion as the mind becomes deadened to the appreciation of things worth while.

What is going to bring the people of this Canada of ours to their senses? Looking the situation squarely in the face, the war, that was to do so much to strengthen our ideals, has set ns back—as real men and real women—a hundred years. The only solution that has ever been offered that seems to contain one shred of comfort is—work. Will our effeminate young men begin to apply themselves in earnest? Will the unemployed laborers go to the farm or the mine or the bush and **produce**—rather than starve or live on charity?

The race we sprang from would starve before they would accept charity, but the race we have bred will accept charity rather than work. Where will it end?

## English Engineer's Opinions of American Roads

That government and municipal highway departments could do nothing more practical or patriotic than to follow the example of Greater London and give work to the unemployed former service men in the construction of public improvements is the opinion of Alfred Dryland, chief engineer for Middlesex County, England, who recently came to this continent for a six weeks' inspection of our highways.

"We are building a fifty-six mile arterial system of new hard-surfaced highways in the environs of London," said Mr. Dryland "of which thirty-five miles are now under way. This work is to cost $6,000,000 and is undertaken at this time to afford work to thousands of unemployed former service men and to provide means for diverting more of our heavy traffic from the heart of London. The cost of the new roads is shared by the general government and the county.

"All told, 5,000 passenger busses are operated on London streets. In addition there are 2,000 sightseeing busses. It is planned to add 2,000 more to those now in use. This will greatly increase the congestion of traffic. Congestion is a much greater problem in London streets than it is in cities here. New York does not approach anything like London in this respect. You have nothing like the proportion of heavy vehicles that we have. I am studying traffic conditions in New York very thoroughly and it is my opinion that motor drivers do not drive as carefully as ours nor have they quite the same 'traffic sense., By this I mean that driving a motor car does not seem to become 'second nature', so to speak, as it does to our drivers in England.

"Future road development in England." Mr. Dryland continued, "will be very much along the line of development here, namely in the direction of asphalt surfaces.

"I came here primarily to study your portland cement concrete roads. I have been somewhat surprised to find how well the cement roads resist the wear of rubber-tired traffic, but in the British Isles concrete roads might be at a disadvantage because we have such large number of iron-shod, steam-driven trucks, traction-engines and tractors. Development in England probably will be along the line of the portland cement concrete base with the asphalt surface.

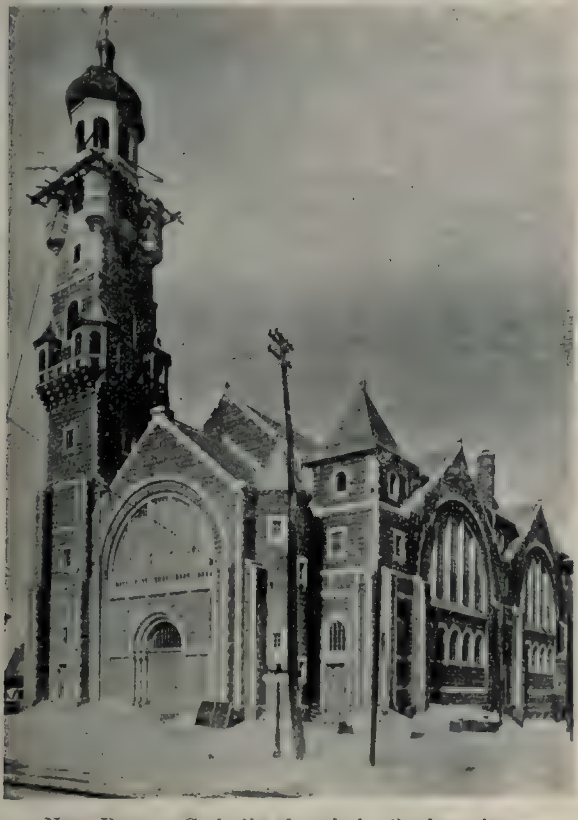
"Road building is making great progress in America but great weakness in your system is your partial development of width. Little attention, also, seems to be paid to the edge of the road. There is a large mileage of roads that are not up to date. You have an enormous area to develop. I have traveled more dangerous roads in the vicinity of New York than in my entire forty years of experience in England. Your roads are dangerous because the paved widths are too narrow for the amount of traffic they bear. There should be a minimum width of thirty feet of pavement, affording room for at least three vehicles to pass."

# Church with Interesting Features

## Parish Church of Saint Coeur de Marie on Grand Allee, Quebec City, Nearing Completion—Details of Design and Construction

The parish church of Saint Coeur de Marie, on Grande Allee, Quebec city, which is almost completed, embodies many interesting features and surely evades comparison with the many other churches in or around Quebec City. It was designed by Messrs. Robitaille & Robitaille, Architects, Lindsay Building, Quebec, in a Romano-Byzantine style adapted, of course, to local conditions.

On the left side of the main facade rises a campanile, 165 feet high, which is more like a minaret associated with the Mohammedan mosques but which adds much picturesqueness to the exterior design. Large and numerous arched windows are provided and the granite walls are reinforced with buttresses.



New Roman Catholic church in Quebec city.

The interior is roofed over with two domes resting on eight arches, 40 feet in diameter, which spring from concrete pillars. These domes and arches are made of tiles; they are of "timbrel vault construction" and were built by the R. Guastavino Company of New York. The height of the main arches is 40 feet while the domes are 55 feet above the floor.

The inside walls and pillars are finished with a cement coating and are intended to be decorated with paintings and mosaics. Beautiful stained-glass windows, commemorating various Saints, are already installed.

The inside dimensions are 189 feet by 75 feet The floor, which is covered with tiles, is built of concrete slabs supported on reinforced concrete beams of 40-foot span. In the basement or crypt is provided a large parish hall with a capacity of 700 people.

Wood trusses support the roof, which is covered with galvanized iron while copper was used on the campanile. All the roofing was made by Eug. Palardeau of Quebec.

The church is heated by a hot water system.

The general contract was awarded in 1919 to Edmond Belanger of Quebec for $173,000.00. The other contractors, all of Quebec, who were engaged in the construction of the building were—carpentry and joinery, C. Emile Morissette, Ltd.; cut stone, Laforce & Frere; tile-flooring, Jobin & Genois; heating and plumbing, Fortunat Gingras; electric wiring, Vandry & Matte; glazing and painting, J. Tardivel.

# Steel Erection Precautions

## Dangers of Collapse in the Building of Steel Structures—Preventive Measures

In most cases the stability of a roof, especially one with trusses, is, as well as a building frame, very different during erection and after completion of the building. During erection the framework of the building is likely to consist only of skeleton members that are not able to develop their full strength because of the absence of supplementary portions of the structure like walls, floors, roof surface, and other elements that tend to hold the principal members firmly in position, prevent their displacement or deflection, and are able to offer large resistance to wind pressure and vibration

It is therefore, true that well-designed and well-built roof trusses, columns and other steel structures that are fully adequate to carry the working loads for which they are proportioned, may be entirely unable to resist comparatively small temporary stresses developed during erection.

### Temporary Bracing

This fact is so well recognized by careful designers that some of them insert extra members in the way of special braces to care for erection stresses that although left permanently in the structure, are no longer necessary after its construction. This, however, is unnecessary if reliance can be placed on the erector to make temporary provision for the stresses and conditions possible during the construction of the building.

Steel trusses, platforms, tanks or bins supported on tall steel columns may be subject to very dangerous overloads during erection, through wind pressure, temporary loadings, hoisting stresses, imperfect connections and ordinary field accidents that might be safely sustained by the finished structure but that cannot be resisted by the incompleted structure.

Usually even very slender columns and light trusses and girders can sustain heavy loads, without impact, if they are symmetrically applied and if the columns, girders and trusses are properly adjusted and maintained in perfect alignment and position. This condition is promoted by the general custom of thoroughly guying or bracing long columns and trusses as fast as they are assembled together and by avoiding heavy loads on them unless special provision is made for their support and distribution.

The principal framework of steel structures frequently consists of transverse bents made up of a long span light truss and two vertical columns that, consider ed as an independent bent, has little stability. Roof trusses having comparitively small working loads to sustain are likely to be very slender and liable to buckle so that sometimes it is necessary to temporarily stiffen them by timber or other reinforcement lashed or bolted on to enable them to be safely handled in erection, although later they may be thoroughly and permanently stiffened with connecting braces and with the roof surface.

### Longitudinal X-Bracing

The framework of a steel building, with or without truss roof, is generally erected in tranverse vertical bents and if the work is done so rapidly that proper bracing between them is omitted, a failure of any part of the building is likely to be progressive and the collapse of one bent may be transmitted throughout the entire building and cause the fall of the whole. This is very easily prevented by the simple expedient of bracing the bents together with longitudinal vertical X-bracing either permanent or temporary. The omission of such bracing, unless the permanent walls and roof are erected as rapidly as the bents themselves, is nothing short of criminal and always invites disaster, which often responds.

A large majority of the serious accidents during the erection of steel frame buildings are due to the omission or imperfection of longitudinal X-bracing that virtually should transform the separate weak independent sections to a combined whole that possesses multiplied strength equivalent to that of a great truss. The use of longitudinals alone to connect the successive bents is probably seldom or never omitted but of itself is inadequate if they serve merely to transmit the stress from one bent to another which if sufficient to cause the collapse of one bent may cause the collapse of all.

### Improper Construction Loads

Another serious erection danger is in the careless or ignorant application of an undue load to a truss or floor, or to a load improperly applied or in the wrong position. Trusses are often so designed that, in the finished structure they can scarcely be overloaded under ordinary conditions while in the unfinished structure a very moderate load may be sufficient to destroy them.

A shed roof in California was built with wooden trusses that, during erection, were overloaded with building materials not placed in the proper position, that caused its collapse. This accident was not investigated and was followed by a similar one about a week afterwards which caused the destruction of a 74-foot span truss and caused the death of one man and serious injury of another. This accident was entirely preventable and inexcusable and in commenting on it the California Safety News, published by the Industrial Accident Commission of the state of California, very pertinently says:

"Both failures were due to unsymmetrical loading. The truss that failed, causing the second collapse, was 74 feet in span and had no counter or knee bracing. No allowance was made for stiffening and bracing the long trusses of this structure during construction.

"The following precautions, if observed, will prevent a recurrence of such a collapse:

1. All long trusses shall be reinforced with counter and knee bracing.

2. No truss or roof member shall be loaded until the truss is completley bolted and all purlins and braces connected.

3. In the case of light trusses having no purlins, temporary struts shall be securely fastened to the top and bottom before the truss is loaded.

4. Concentrated loads placed during construction shall in no case exceed 3,000 pounds, or a 1,000 feet board measure of lumber.

5. For short trusses where the derrick or loading device can distribute the load over the entire truss, the load shall not exceed the total amount of the roof sheathing supported by the member in the finished structure.

6. All sheathing shall be evenly and symmetrically distributed across the entire truss with not more than one-third of the load in the middle of the truss.

7. For long trusses where the derrick or loading device cannot reach over the entire truss, the load shall be distributed across the middle of half the truss and shall not exceed two-thirds of the total amount of the roof sheathing supported by the member in the finished structure. The loads shall at all times be symmetrically placed.

8. All loads shall be evenly spread in laying the roofing on either side of the center line and unsymmetrical loading shall be avoided.

9. If concentrated loads are required after the roofing has been spread, they shall be placed only over the posts at the ends of the trusses."

## Error in Advertisement of Brown Hoisting Machinery Company

The advertisement of the Brown Hoisting Machinery Company, Cleveland, Ohio, on page 5 of the Sept. 14 issue of the Contract Record had an error due to one of the figures in the first line becoming broken on the press and getting by unnoticed. This was the fiigure "3" which should have made the headline read "A 30% saving on this excavating work."

## Big Road Congress in January

In view of the fact that road building now forms the major part of the construction industry, the announcement of the board of directors of the American Road Builders' Association that its next annual convention and good roads show will be held in Chicago, Ill., on January 17, 18, 19 and 20 is of particular interest. Last year the association held its convention and show at the Coliseum in Chicago and it was declared by all attending to be the greatest and most successful ever held. Because of the central location of Chicago, the directors of the association have decided to hold the convention in that city again. Plans are now under way to make the coming convention even greater than that of last year.

In addition to the papers and discussions on important highway problems by leading road builders of the country, the exhibition of road machinery will be an extremely valuable feature. During the last decade, road building methods have been revolutionized by the introduction of labor saving machinery. In 1919, the last year for which figures are available, more than $100,000,000 worth of road machinery was manufactured in the United States, according to the U.S. Department of Commerce. This is greater than the value of all other construction machinery produced in that year and shows the relative importance of the road building industry.

With the central location of Chicago, the immense amount of money available and the increased interest in road matters, the directors of the association are of the opinion that the coming convention and show will surpass any previously held and that highway engineers, contractors and officials will attend in greater numbers than ever before.

# Town Planning Conference in Montreal This Week

Sept 28, 1921.

Plans have been perfected for the town planning conference, under the joint auspices of the Town Planning Institute of Canada and the Montreal City Improvement League, whch will be held at the Place Viger Hotel on September 29 and 30, and October 1st, with the annual banquet to be held at the Place Viger on the evening of Thursday, Sept. 29. It is expected that there will be about 150 or more delegates present for the meetings, the majority from Montreal and other Canadian cities. It is also expected that there will be experts on town planning from Boston, New York, Chicago and other centres, who will give advice regarding the experience of such places in the upbuilding of modern cities.

A feature of the conference will be the holding of an exhibition of plans for city development, including a number showing the development of Montreal over a number of years past, which is expected to prove of particular advantage.

The conferences will be bilingual throughout opening with a French Day under the chairmanship of Mr. E. Deville, president of the Town Planning Institute. This will open at the Place Viger at 10.30 on the morning of Thursday, Sept. 29 when addresses of welcome will be given by Mayor Mederic Martin in French, and F. W. Stewart, president of the City Improvement League, in English. These will be replied to by the chairman of the convention, after which the regular programme will proceed as follows:

11 a.m., "The Art of Town Planning," by Mr. A. J. Lavoie.

"The Main Thoroughfares of Montreal," by Mr. G. R. MacLeod, engineer of technical services, Montreal.

"The Automobile and Municipal Development," by J. A. Duchastel.

### Afternoon Session.

Chairman, E. Deville.

"Underground Electric Wiring," by Mr. L. A. Herdt, professor of electricity, McGill University.

"Common Transportation and Development of Modern Cities," by Mr. Paul Seurot, chief engineer, tramways commission.

"Congestion in Cities," by Mr. Aime Cousineau, sanitary engineer, Montreal.

"Underground Strata of Montreal," by Mr. Adhemar Mailhot, professor of geology, Polytechnique School.

"Municipal Art as Seen by a Sculptor," by Mr. Henri Herbert, R.C.A.

The annual banquet will be held at the Place Viger on Thursday evening, when the chair will be taken by Mr. F. W. Stewart, president of the City Improvement League, leading speakers responding to the toasts of the Provincial Government, the City and Our Guests, the dinner being conducted on a bilingual basis.

The second day will proceed in English, presided over by Mr. Walter J. Francis, vice-president of the Engineering Institute of Canada, with the following programme. "Suburban Development in Montreal." by Leonard E. Schlemm.

"The Tenure of the Land and its Effects on Town Planning," by H. L. Seymour, Toronto.

"The Control of Sub-divisions," by Malcolm D. Barclay.

"Economics of Organic Planning," by Noulan Cauchon vice-president, Town Planning Institute, chairman Plan Commission of Ottawa.

"City Mapping with Special Reference to Surveying by Aeroplane." by Douglas H. Nelles, supervisor of Topography, Geodetic Survey of Canada, honorary secretary Town Planning Institute.

### Afternoon Session.

Chairman, J. Emile Vanier, president of the Association of Architects of Quebec Province.

"The Growth of a City with Special Reference to Edinburgh," by Ramsay Traquair, professor of Architecture, McGill University.

"The Town Planners' Problem in Paris," by Adrian Berrington, professor of Architecture, Toronto University.

"Parks and Park Systems," by Fred. G. Todd, landscape architect, Montreal.

"The Relation of City By-Laws to Town Plans," by Percy E. Nobbs.

### Friday, Sept. 30th.

Chairman, Mr. Victor Morin, president of St. Jean Baptiste Society.

"Le Plan Raisonne," by Noulan Cauchon.

"The Montreal Situation," by James Ewing, vice-president Town Planning Institute.

Address by M. Joseph Beaubien, president of the Union of Municipalities of the province of Quuebec.

"The Railway Problem in Relation to the City," by W. F. Tye, past president, Engineering Institute of Canada, late chief engineer C. P. R.

### Will Inspect Harbor.

The convention will close with a morning session on Saturday, Oct 1st, under the chairmanship of Mayor P. W. McLagan, of Westmount, with the following programme:

General discussion on the law and financing of the city plan, led by W. D. Lighthall, K. C., member of former Metropolitan Parks Commission.

This will be followed by a luncheon at the Place Viger, presided over by Ald. J. A. Brodeur, president of the Metropolitan Commission of the Island of Montreal. Following the luncheon the delegates will be guests of the Montreal Harbor Commissioners on a river excursion with an inspection of the harbor, which will conclude the work of the conference.

# Self-Corrosion in Cast Iron Pipe

## Investigation of Pipe Line at Selkirk, Man., Indicates that Stray Current Electrolysis is not as Responsible for Corrosion as is Often Supposed

Evidence has been gradually forthcoming, from a number of independent investigators, states an article in the Journal of the American Institute of Electrical Engineers, that cast iron pipe is not the indestructible material that it was formerly supposed to be by engineers; and the recognition of the possibilities of self-corrosion by responsible engineers and chemists ought to have considerable bearing upon the numerous controversies respecting damage to water pipes, gas pipes, and lead cables, which is usually charged against stray current electrolysis from electric railways, if there is a railway near enough to receive the blame for the damage.

A perplexing feature that sometimes arises in an electrolysis situation is the persistence of pipe corrosion at spots well removed from the pipe joints, in areas where the pipes could not have been electrically positive to the surrounding earth. When the soil carries electrolytic salts in solution, self-corrosion is easily possible, in places where stray current electrolysis could not happen.

The facts that are now being brought to light about the possibilities of self-corrosion, coupled with the availability of recently devised methods for determining conclusively whether a pipe is positive or negative to the earth, will enable electrolysis situations to be handled in the future on a basis of proved fact instead of prejudice, fear or conjecture; and professional electrical engineers, called into electrolysis situations, will do well to bear this in mind.

### Chemical Corrosion

The following investigation of a case of chemical corrosion of iron pipe is reported by W. Nelson Smith, consulting electrical engineer of the Winnipeg Electric Railway Company.

A party of professional chemists and engineers from Winnipeg made a personal inspection of a six-inch water main, about 100 feet of which had been recently exposed in the course of excavating for the pipe tunnel between the new Selkirk hospital and the boiler house.

As the water supply system of the hospital is secured from wells drilled on the property to a depth of 250 to 300 feet, and the piping system is entirely separated from the Selkirk water supply, and as the hospital is more than half a mile from the western outskirts of the town, and not less than 1¼ miles from the northern extremity of the Selkirk trolley line, it was said to be quite outside any possible path of stray current from the electric railway. The only electric current on the property is a 60-cycle alternating current for lighting, and the United States Bureau of Standards, it was pointed out, had proved by exhaustive and long-continued experiment, that it was impossible for an electric current of this character to cause destructive electrolytic action on buried metal structures.

The pipes examined, although they had not been laid for more than eight years, were shown to be affected by some corrosion of the cast iron, well advanced in many spots, not only near the joints but in the middle of the pipe.

The progress of corrosion was observed in its various stages, and the corroded metal in the pits eaten into the pipes was similar in appearance to the products of corrosion observed on damaged water pipes in Winnipeg. All such damage, wherever it had happened in the city, it was stated, had always been attributed solely to electrolysis from stray currents leaking from the electric railway tracks.

The presence of soluble salt crystals in considerable quantity was also observed by all the party on clay freshly excavated from new trenches in the street in front of the hospital. The similarity of this clay and its salt content, to the clay and its contained salts as met with all over Winnipeg and vicinity was remarked upon by all present.

### No Stray Current Electrolysis

This water pipe had thus been imbedded in earth containing salts that are known to be chemically active, and further, by reason of its location, had been entirely free from access of stray direct current, which can only dissolve the metal where it leaves a buried pipe to enter the surrounding earth. Stray current electrolysis was therefore admitted to be impossible under the circumstances.

The only inference that could be drawn from the facts noticed by the party was that the observed corrosion could only have been caused by the chemical activity of the solutions of the so-called alkaline salts.

It was further pointed out that it had also been recognized for several years past, by practising civil engineers, and more recently by public authorities and the public generally, that these alkaline salts, the sulphates, chlorides, carbonates and bicarbonates of magnesium, calcium and sodium, which are widely distributed through the soil of western Canada, are very corrosive to concrete made of Portland cement, no matter how carefully the concrete is mixed and deposited.

Chemical research work started about a year ago under the direction of W. Nelson Smith, M.E., and conducted personally by Dr. J. W. Shipley in the laboratory of the University of Manitoba, has brought to light many facts respecting the behavior of commercial cast iron, lead, and copper, in contact with neutral solutions of the above so-called alkaline salts. This research is now so far advanced that a definite report on the main outstanding facts will be forthcoming during the present summer.

# Some Problems Encountered by the Waterworks Engineer

By W. C. Hawley. Chief Engineer and General Superintendent, Pennsylvania Water Co.
From a paper presented before the Engineers' Society of Western Pennsylvannia.

In the design of a waterworks system, the consulting or practicing engineer usually has sufficient time to study the various phases of the problem in hand, but sometimes in construction it becomes necessary in an emergency to change plans quickly, to substitute one available material for another which is not at hand, and to do things which are not found in the books. The operating engineer faces many problems of this kind—instances where it is necessary to act immediately and to use such material as may be at hand.

### Method of Repairing Crack in Standpipe.

As an illustration, in January, 1897, the author was called out of bed one night and told that "the stand-pipe has busted." The message came from the engineer at the pumping station, the stand-pipe being located within a few feet of the station. Getting to the station as quickly as possible, it was found that water was flying in all directions from the vicinity of the bottom of the stand-pipe. The stand-pipe was 15 ft. in diameter and 140 ft. high, built of wrought-iron plates, the bottom resting on a rubble masonry foundation, about 8 ft. above the ground. The stand-pipe was in place, and it was evident that the vertical sheets had not been damaged. Beyond that, it was impossible to tell what had happened, even at the expense of a ducking. The stand-point was emptied at once, and, upon getting into it, it was found that one of the bottom plates had broken apart for a length of 5 ft., and that the plate was cracked and corroded for a total length of more than 9 ft. This had occurred immediately over the calking edge of the adjoining plate. Because of the height of the stand-pipe, its small diameter and the fact that the locality was subject to high winds, repairs had to be made as quickly as possible.

There was no boiler shop within 50 miles. The shop of the firm which erected the stand-pipe was over 100 miles distant and by telephone it was learned that it would take some days to send men and get the measurements, prepare the necessary patch plate and put it in place. A mechanic was sent from the shop at once to take the measurements, but some plan of tempory repairs had to be devised by which the stand-pipe could be made tight enough to hold a sufficient amount of water to insure its safety in case of high wind.

It was decided to cover the crack with a cement made as follows—fine cast-iron boring, 98 parts; flour of sulphur, one part; sal ammoniac, one part. The ingredients were thoroughly mixed dry, boiling water added and the resulting paste trowled over the crack to a thickness of 1½ or 2 in., being spread out for a distance of 3 or 4 in. each side of the crack. The cement set quickly and the next day water was pumped into the stand-pipe and the patch proved to be water tight. The stand-pipe was then filled and was in use for some days before the mechanics arrived with the plate.

Before the stand-pipe was emptied for placing the plate, it was guyed with cables. The sheets adjoining the crack were cut out and the patch plate put in place and secured with tap bolts. It was not until the plates had been cut out that the cause for the failure became evident. There was no joint of mortar nor cushion of sand, as there should have been, between the bottom of the stand-pipe and the top of the stone foundation.

### Keeping Old Plant in Operation While Building New One.

The operating engineer also has to handle reconstruction problems which involve not only the design and carrying out of plans and specifications, but he must keep the old plant going —maintain service— while the new one is being built. Frequently, construction of the new is not begun until the old has down or been outgrown, which makes matters materially worse.

An instance of this kind was the enlarging of the pump station of the Pennsylvania Water Co., at Nadine, on the Allegheny River about 1½ miles above Brilliant pumping station, in 1903-1904. The old pumping station consisted of an octagonal building about 60 ft. across, over pump pit 38 ft. in diameter and about 40 ft. deep. In this pit there were two 6,000,000-gal. quadruple-expansion Nordberg pumping engines. It was necessary to construct a new pump pit large enough for two 10,000,000-gal. engines, and erect a new pumping station which should cover both pits, with sufficient room for a crane and auxiliary machinery. There was also involved, of course, the work of connecting suction and delivery pipes; the installation of two additional boilers, for which ample space existed in the boiler room; and the erection of a new and larger steam-pipe with connections. The avaiable space for the new pumping station was limited. There was barely room, between the hill and the Allegheny Valley. R. R. tracks, for the boiler house and the old pumping station, and the only available site for the new station was between the old station and the highway, which was improved county road. The available space was further restricted by the fact that the 30-in. force main started up the hill from a large brick vault leaving barely space enough for the new pump pit and the necessary floor space between the vault and old pump pit. The site of the pumping station was an old ravine which had been filled in with 12 to 20 ft. of earth and cinders, the stream which flowed down the ravine having been diverted into a culvert, as shown on the plan.

Plans for a new circular pump pit 45 ft. in diameter and 49 ft. deep were prepared after the necessary space for the pumping engines had been determined, and then plans were begun for the pumping station building. Before the new pump pit could be built it was necessary to move the delivery line from each of the pumping engines then in service. Both were 24-in., cast-iron pipe-lines. The one toward the hill was moved, the change in location being accomplished by the use of bends. The other was replaced by a riveted steel pipe. In this way the old pipe could be kept in service until the new one had been laid, and it was then only necessary to break out the old one and connect the one in at each end.

Water was brought to the old pump pit through a 6-ft. tunnel connecting under the railroad tracks to the pipes from the filter cribs in the river. No provision had been made for a connection to this tunnel and it was necessary to cut into it and set in it a 48-ft. tee and valves. From the tee branch a new tunnel was run to the new pump pit and the suction pipe in that pump pit connected to the tunnel. At the time this work was done the demand for water exceeded the capacity of one of the 6,000,000-gal. pumping engines, making it necessary to run one engine all of the time and both engnes part of the time. The engines were pumping against a total head of more than 600 ft. and, on account of low water in the river at times and the consequent difficulty of getting enough water from the filter cribs, the service had been hard on the engines and one of them in particular needed rather extensive overhauling and repairs, but it was impossible to shut it down long enough to make the repairs needed. It was frequently necessary to shut that engine down for temporary repairs and occasionally the other engine needed attention, which made it extremely difficult to keep a sufficient supply of water in the reservoir to permit shutting down both engines long enough to make the tunnel connection and to change the the delivery pipes. To add to the difficulties of the problem, there were two floods in the Allegheny River during the progress of the work which not only stopped the work, but in each instance floating ice took the top off the intake manhole at the river and permitted raw water to get to the pumps, making it necessary to shut them down. At another time, a check in a check-valve on the delivery line of the engine toward the hill broke loose from its trunnion and smashed back through a large four-way special casting making it necessary to have a new casting made in Milwaukee and shipped by express.

As previously stated the pumping station is located on a fill in what was an old ravine. To have carried the walls of the building to bed-rock would have been expensive and would have increased the difficulty of relocating the delivery pipes. After study of this phase of the problem, it was decided to build piers of centers approximately 19.5 ft., and to carry the walls of the building on reinforced concrete beams between these piers. In construction it was found that at only one place did the pipe interfere with a pier and in that case the pier was carried on an arch supported on a pier on each side of the pipe.

The building of the new pump pit and the foundations for the pumping station was done by contract on a " cost plus" basis as there was no possible way of estimating closely what the work would cost. Sometimes when ready to make a connection or move a pipe, shortage of water made it impossible to shut down the station long enough to carry out the work, and it was necessary to wait until the reservoir had been replenished. The two floods interfered seriously, but ultimately the work was completed and the pumping station erected.

### Needs for Care in Laying Pipe Lines.

There have been two breaks in that portion of the 42-in. line which was left in service. These occurred under normal working pressure although the pipe had been tested to 50 lbs. in excess of the working pressure before it was put into service. Both of these breaks were found to be caused by the pipe resting upon a stone or rock, and two breaks have occurred in the 30-in. line from the same cause. This matter was looked after with scrupulous care in the laying of the 36-in. pipe and there has been no break in that pipe-line since it was laid. This experience calls attention to the provision not infrequently seen in specifications for large pipe-lines, especially in soft ground, to the effect that the pipe shall be laid on one or two wooden blocks or saddles per length. Concentrating the load at one point is dangerous, and while the blocking may be made to fit the pipe so that the concentration would be less than in the case of a pipe bearing upon a rock, still it is wrong in principle. It is better to give the pipe a uniform bearing and it can be done by proper care in bottoming the ditch and backfilling.

Cast-iron pipe, especially the small sizes, should be thoroughly bedded when laid. This is a matter which sometimes is not given the attention it deserves. Many of the breaks which occur in newly laid pipe of adequate thickness doubtless occur from uneven settlement due to improper bedding of the pipe when laid. After pipe has been laid long enough to become thoroughly bedded, a considerably higher pressure may be put upon it than would be considered safe for the weight of the pipe used. The author knew of a case where 4, 6, and 8-in. pipe as light as 20, 30, 40, lbs. per foot, respectively, were laid in a valley where the normal pressure did not exceed 90 lbs per square inch. Some years later, as the population increased and building extended onto the hills adjoining the valley, it was necessary to build a reservoir at an elevation which increased the pressure on these pipes to from 150 to 165 lbs. per square inch, and although some breaks were expected, very few occurred. Had new pipes been laid for such pressures the weights would have been 21, 33, and 47 lb., respectively.

### Experience with Earth Slips.

We have recently heard a great deal regarding earth slips. The tography and geology of this district are such as to cause many slips on our side-hills. The immediate cause is sometimes difficult if not impossible to control. An interesting case of this kind occurred some 15 or 18 years ago to one of the banks of the Pennsylvania Water Co.'s No 2 Reservoir on the hill in Braddock Township immediately back of—that is, north-east of—the borough of North Braddock. had been some slight evidence of a settlement in this controlled the water supply of the Turtle Creek Valley. The south bank of this reservoir was approximately 30 ft. in height. It was an earth bank with an inside slope of 2 to 1 and an outside slope of 1.5 to 1, the inside slope being lined with concrete for its entire height, and the outside slope sodded. The top of embankment had a width of 11 ft. There had been some slight evidences of a settlement in this bank, but none of a slip, and it was thought that the settlement was caused by a consolidation of the material due to its height. There was no evidence of leakage through the bank. One night in the early spring of 1903, there was a sudden settlement in this bank to the amount of more than 1 ft. This was noticed by the watchman and immediately the water was drawn from the reservoir. The settlement of the bank continued, and there was evidence of the slipping of the bank at its toe immediately above the road. A 16-in. cast-iron pipe by-pass was laid around the reservoir so that water could be supplied around it while repairs were in progress. The center of the settlement and slip seemed to be adjacent to and over the 48-in outlet pipe. The embankment was removed and this pipe uncovered. There was some evidence of slight leakage and it was taken up and relaid. The embankment was then rebuilt and in order to get a somewhat better foundation the center-line of the new portion of the embankment was shifted about 50 ft. into the reservoir at its westerly end, making an angle in the southerly embankment of the reservoir which had formerly been straight. Great care was taken to join the new portion of the embankment with the old. When the repairs had been completed and the reservoir put into service there was, after some weeks, evidence of settlement and slip of the new portion of the reservoir bank. It was then determined to drill into the rock under the toe of the embankment and set 20-ft. lengths of 8-in. well casing in concrete, the casing being filled with concrete, also. The casing was spaced 2.5 ft. between centers. After some months, still further settlement and slip were evident, and a shaft was sunk, near the center of the portion of the embankment which appeared to be moving, until rock was encountered. Then the cause of the slip became evident. The surface of shale rock of the hill was covered with a layer of heavy clay, less than 1 in. thick, on which the embankment was sliding. From the shaft, tunnels were run in all directions through the extent of the slip and this layer of clay removed, the surface of the rock made rough and the tunnels backfilled and thoroughly tamped. The embankment had only settled a few inches. It was again filled to the grade, and there has been no further settlement or slip. The plans for this reservoir showed that after removal of the top soil the earth upon which the embankment was placed was excavated in a series of steps and the embankment then constructed. The slope of the original surface was about 1 to 3. The existence of the layer of clay on the rock was not revealed by the test pits which were dug, nor in the excavation for the reservoir during its construction.

## Current Wages in the Building Industry in Canada, August, 1921

*(Rates per hour, as reported to Association of Canadian Building & Construction Industries)*

*(44 Central Chambers, Ottawa)*

| CITY | Brick layers | Masons | Tile Setters | Stone Cutters | Marble Cutters | Planer Men | Cement Finishers | Struct'l Steel Erectors | Reinf'd Steel Workers | Carpenters | Plasterers | Wood Lathers | Metal Lathers | Painters | Electricians | Sheet Metal Workers | Roofers Slate Tile | Plumbers Steam-fitters | Hoisting Engineers | Hod Carriers | Laborers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PRINCE EDWARD ISLAND** | | | | | | | | | | | | | | | | | | | | | |
| CHARLOTTETOWN | .75 | .80 | | .80 | .60 | .50 | .60 | | | .50 | .50 | .50 | | 40-.60 | [illegible] | .50-.75 | [illegible] | .75 | [illegible] | .40 | .50 |
| **NOVA SCOTIA** | | | | | | | | | | | | | | | | | | | | | |
| HALIFAX | .75 | .75 | .75-1.00 | [illegible] | .80 | .66 | .60-.75 | .75-.90 | .75-.90 | .66 | .75 | .66 | .66 | .66 | .75 | .70 | .66 | .70 | .75 | .40-.50 | .30-40 |
| **NEW BRUNSWICK** | | | | | | | | | | | | | | | | | | | | | |
| MONCTON | .80 | .80 | [illegible] | .80 | [illegible] | | .70 | | | [illegible] | [illegible] | 3.50 per M. | [illegible] | [illegible] | .60 a .65 | .60 a .65 | .60 | .65 | | [illegible] | .30-.45 |
| ST. JOHN | .90 | .90 | .70 | .90 | .65 | | [illegible] | | | .50-.60 | [illegible] | [illegible] | .50-.60 | .75 | .50 | [illegible] | [illegible] | [illegible] | [illegible] | .35-.40 | .30 |
| **QUEBEC** | | | | | | | | | | | | | | | | | | | | | |
| MONTREAL | .80-.90 | .60-.85 | .70 | .75 | .75 | .60 | .60-.75 | .50-.75 | .65 | .50-.65 | .70-.80 | Piece Work | Piece Work | .55-.65 | .65 | .50-.75 | .60-.65 | [illegible] | .40-.50 | 40-.45 | .25-.40 |
| QUEBEC | .70 | .65 | .75 | .60 | [illegible] | | | | | .50 | .70 | 70 | | 45 | .55 | [illegible] | [illegible] | .50 | | 4.50 day | 4.50 day |
| SHERBROOKE | .90 | 75 | | | | | | | | .50 | .75 | 60 | .60 | | .50-.60 | [illegible] | [illegible] | [illegible] | [illegible] | .30 | [illegible] |
| **ONTARIO** | | | | | | | | | | | | | | | | | | | | | |
| BELLEVILLE | .75 | .75 | | .75 | | .60 | .75 | | | .60 a .65 | .75 | 65 | | .65 | 1.00 | .90 | | [illegible] | | .45 | .40 |
| BRANTFORD | [illegible] | .90 | [illegible] | [illegible] | .90 | .60 | [illegible] | | | .75 | .90 | .60-.75 | .60-.85 | .50-.75 | .75 | .60-.75 | .60-.75 | .85 | .85 | .45 a .50 | .35-.45 |
| BROCKVILLE | 1.00 | 1.00 | | | | | 1.00 | | | .65 | 1.00 | | | .75 | .75 | | | .85 | | .50 | .35 a .40 |
| FT. WILLIAM | 1.15 | 1.15 | | 1.15 | | | | | | .75-.90 | .90-1.15 | Piece Work | Piece Work | .65 | .75 | .75-.90 | | .90 | .75-.90 | .35-.45 | .35-.45 |
| GUELPH | 1.00 | 1.00 | | 1.00 | 1.00 | | .50 | | | .77½ | 1.00 | .50 | .50 | [illegible] | .55 | .60 | | .75 | | 50 | .35-.50 |
| HAMILTON | .90 | .90 | .85-1.00 | [illegible] | .90 | .57 | .50-.57 | .80 | .50-.60 | .75 | [illegible] | .75 | .75 | .62 | .75 | [illegible] | .70 | .80 | .75 | .50 | .35-.40 |
| KINGSTON | .85 | .85 | .85 | .75 | .75 | | .85 | .65 | .65 | .75 | .85 | .60 | [illegible] | .65 | .65 a .70 | [illegible] | .80 | .80 | .60 | 40 a .45 | .35-.40 |
| LONDON | 1.00 | 1.00 | | 1.00 | | | .60-.70 | | | .75 | 1.00 | [illegible] | .80 | .70 | .70 | .60-.65 | [illegible] | [illegible] | | [illegible] | 50 |
| OTTAWA | .90 | .90 | [illegible] | [illegible] | .90 | .70 | | | | .75 | .85 | | | .65 | .80 | .75 | .75 | [illegible] | .75 | .50 | [illegible] |
| PETERBOROUGH | .90 | .90 | | [illegible] | .75 | | 1.00 | | | .80 | 1.00 | .75 | .75 | [illegible] | .80 | .75 | .75 | [illegible] | .60 | [illegible] | .40 |
| PORT ARTHUR | 1.15 | 1.15 | | 1.15 | 1.15 | 5.00 per day | .50-.60 | .70-.90 | .50-.60 | .70-.90 | 90-1.15 | Piece Work | | .55-.65 | .75 | [illegible] | | .90 | .75-.95 | [illegible] | .30-.45 |
| SAULT STE MARIE | 1.02½ | 1.02½ | 1.02½ | 1.02½ | 1.02½ | | [illegible] | .85 | .85 | .75 | 1.02½ | .75 | .75 | .75 | .65 | .65 | | .90 | .85 | 55 | 40-.45 |
| ST. THOMAS | 1.00 | 1.00 | 1.00 | | | | .65 | | | .60-.80 | [illegible] | .80 | [illegible] | .65-.80 | [illegible] | .80 | 60. | .80 | 1.00 | [illegible] | [illegible] |
| STRATFORD | .90 | .90 | | [illegible] | | .55-.65 | .75 | .50-.60 | | 65-.75 | [illegible] | .75 | .75 | .50-.65 | [illegible] | .60-.75 | [illegible] | .60-.75 | | .65 | .40-.55 |
| TORONTO | 1.00 | 1.00 | 1.00 | [illegible] | 65-70 | [illegible] | .65-.70 | .85 | .55 | [illegible] | 1.00 | [illegible] | [illegible] | .75 | 87½ | [illegible] | 1.00 | [illegible] | .70-.80 | .50-.75 | .40-.50 |
| WINDSOR | 1.15 | 1.15 | 1.15 | 1.12½ | .75-.80 | .75-.90 | .65-.80 | .65-.75 | | [illegible] | 1.12½ | [illegible] per yd | .09-.10 per yd | [illegible] | [illegible] | [illegible] | [illegible] | .97½ | .75-1.00 | .65 | .50 |
| **MANITOBA** | | | | | | | | | | | | | | | | | | | | | |
| WINNIPEG | 1.15 | 1.15 | 1.00 | 1 & 1.12½ | 1.10 | .90 | | 1.10 | | [illegible] | 1.05 | .90 | [illegible] | .81 a .86 | .70-.90 | .82½ | | 1.00 | .90-1.10 | | .47½-.55 |
| **SASKATCHEWAN** | | | | | | | | | | | | | | | | | | | | | |
| MOOSE JAW | 1.15 | 1.15 | | | | | 1.15 | | | .80 | 1.15 | .08 yd | .08 yd | .75 | .90 | .85 | | .90 | | .60 | .45 |
| REGINA | 1.15 | 1.15 | [illegible] | 1.00 | .85 | .90 | 1.15 | | | .85 | 1.15 | .08 yd | .08 yd | .82½ | .85 | [illegible] | .80 a .85 | .90 | 70 a 75 | | 45 |
| SASKATOON | 1.15 | 1.15 | 1.00 | 1.00 | 1.00 | 1.00 | .85 a .90 | 1.10 | .85 | [illegible] | 1.05-1.10 | .07 yd | .06½ yd | .70-.90 | [illegible] | .90-1.00 | 90 | 90-1.00 | 75 .80 | 40-.50 | .25-.40 |
| **ALBERTA** | | | | | | | | | | | | | | | | | | | | | |
| CALGARY | 1.15 | 1.15 | 1.00 | 1.00 | 1.00 | 1.00 | 1.15 | 1.10 | 1.10 | .90 | 1.15 | 4.00 per M. | .95 | .80 | 1.00 | 90 | | 1.05 | $1-1.10 | 5.50 day | 50-.60 |
| EDMONTON | 1.15 | 1.15 | 1.00 | 1.00 | [illegible] | | .90 | 1.25 | | .85 | .90 | .08 yd | | .80 | 95 | 95 | | 1.00 | | 50 | 50 |
| **BRITISH COLUMBIA** | | | | | | | | | | | | | | | | | | | | | |
| VANCOUVER | 1.06¼ | 1.06¼ | 1.00 | 1.06¼ | 1.06¼ | | 1.06¼ | 1.12½ | 1.00 | .81¼ | 1.06¼ | 1.00 | 1.25 | .81¼ | 1.00 | 90 | | 1.00 | 1.12½ | .75 | 50-.56¼ |
| VICTORIA | 1.00 | 1.00 | 1.00 | [illegible] | 1.00 | 1.00 | .62½ | 1.00 | .82½ | .75 | 1.00 | 1.00 | 100 | 62½ | 1.00 | 87½ | 87½ | .90 | 70 a 85 | .56¼ | 55 |

# Latest Developments in the Activated Sludge Process of Disposal

## This Method is Still in the Experimental Stage, but Facts so far Ascertained Indicate its Excellent Purification Features

By HARRISON P. EDDY, before the Western Society of Engineers

It is the object of this paper to touch briefly upon a few of the most interesting features of the activated sludge process and to point out the facts that have been rather thoroughly demonstrated and of which we are comparatively certain, and to indicate those which are still in doubt and upon which more investigational work and experience are required to determine the natural laws which govern and to perfect methods of procedure. In venturing to classify certain conditions as established facts, it is recognized that the process as a whole is still in the experimental state, that there are many conditions under which it has not been tested, and that circumstances may exist under which those features which we now feel are closely understood will present unexpected difficulties and uncertainties.

### Extent of Purification Accomplished.

One of the bright spots in the experience with activated sludge is its high efficiency as a process of sewage purification. This much at least may be said to be well established. At Houston, Tex., it is stated by City Engineer McVea, that "fish have lived in the outer chamber (effluent) for more than a year."

So large a portion of the suspended solids and colloids may be removed that under ordinary conditions the effluent will be clear and contain but very little suspended matter; from 5 to 20 p. p. m., as a rule.

The sweeping process by which the colloids are absorbed, or coagulated, is also effective in reducing bacteria—not by destroying them but by physically removing them.

In many cases color may also be removed, probably by action similar to that of mordants.

In the case of odors, some may be oxidized directly and some absorbed, the resulting effluent being comparatively free from odors noticeable to the ordinary observer.

While it may be proper at the present stage of development to assume that in general purification may be carried to almost any extent desired, it is important to consider carefully the character of the sewage or wastes to be treated for there may be disturbing influences similar to those which appear to have been important at Worcester. There—probably because of the acid iron wastes from the wire mills—the extent of purification was decidely limited, notwithstanding the use of very large quantities of air, a goodly period of aeration and re-aeration of the sludge.

### Aeration.

The aeration feature which has been more generally studied than any other portion of the process, as at Milwaukee, Cleveland, Worcester, and Packingtown, and Stockyards in Chicago, and elsewhere, apparently is comparatively well understood.

Air is utilized for two purposes—for maintaining aerobic biological conditions and for agitation. Agitation, however, may be accomplished by other means, such as purely mechanical devices.

The oxygen requirements for the support of aerobic conditions are relatively small. Crawford and Bartow found that only 5 per cent. of the oxygen of the air used for aeration, appeared to be utilized, basing their conclusions upon analyses of the air entering and the gases escaping the aeration tank. The writer found only 10 per cent. of the oxygen disappearing in the case of strong tannery wastes. If the oxygen supply is to be obtained from air blown into the sewage, there must be sufficient opportunity for the sewage to dissolve out the oxygen while the air is passing through it.

The quantity of air required for agitation is very large. It is necessary to provide sufficient agitation to prevent the heavy suspended solids from settling down on to air diffuser plates and thus clogging them. Removal of suspended matter by fine screening, is a substantial aid in preventing such trouble. Even sewage which has passed a fine screen having opening ⅛-in. by 2-in. may contain sufficient solids of this character to cause clogging of plates if the air supply be permitted to fall much below 1 cu. ft. per minute per square foot of plate area. By finer screening it might be possible to reduce this quantity slightly. Whatever be the character of the sewage the volume of air must be sufficient to prevent any accumulation of solids upon the diffuser plates.

### Amount of Air Required.

For ready estimation of the quantity of air which will be required for biological action and for agitation, more data are needed than are now available. While the strength of sewage has a very important bearing, a comparison of the results of analyses with the quantity of air used at the several activated sludge plants, with a view to demonstrating this relation, is very disappointing. This is because of differences in methods of chemical analysis, lack of important determinations in some cases, differences in methods of operation, and many other dissimilar details. There are so many of these unharmonious features that it is only by detailed study of each case, and a comparison of the conditions with those of the project under consideration, and the exercise of judgement, that it is possible to arrive at a safe estimate.

As a general statement where the aeration is carried out in continuous flow tanks of 10 to 15 ft. depth, with area of diffuser plates in proportion of 1 to 6, of tank area and a period of aeration of about 6 hours, the quantity of air may be about as follows:

| | |
|---|---|
| For rather weak domestic sewage .. | 1.0 cu. ft. per gal. |
| For strong municipal sewage containing some industrial wastes not particularly detrimental to bacterial life ...................... | 1.5 cu. ft. per gal. |

| | |
|---|---|
| For weak municipal sewage containing considerable industrial wastes some of which are detrimental to bacterial life, as for example acid-iron wastes ................ | 2.0 cu. ft. per gal. |
| For strong municipal sewage containing considerable industrial wastes some of which are detrimental to bacterial life, as for example, acid-iron wastes. ........ | 4.0 cu. ft. per gal. |
| For municipal sewage containing sufficient industrial wastes not specifically inhibitive of bacterial life, to decidely influence the composition of the sewage e. g. packinghouse, tannery, etc. .... | 3.0 cu. ft. per gal. |
| Strong packinghouse wastes ...... | 4.0 cu. ft. per gal. |
| Strong tannery wastes containing a very large proportion of colloids but settled before aeration ...... | 6.0 cu. ft. per gal. |

### Re-aeration of Sludge.

The evidence is conflicting as to whether there is advantage to be gained from sludge reaeration. If the sludge is dense, i. e. contains 2 per cent. to 3 per cent. of solids, the air appears to accumulate in large bubbles and escape from the surface at irregular intervals. This tendency seems to render the air less effective as a means of agitation and possibly interferes to some extent with the uniform distribution of the dissolved oxygen throughout the sludge. A test at Milwaukee indicated that there was not sufficient advantage to warrant the adoption of this feature. On the other hand, Pearse found that in the treatment of Packingtown sewage the return of re-aerated sludge showed "somewhat smaller requirements in the amounts of air needed, and a reduced volume of sludge to be returned.

If the rate of air suply be uniform throughout the 24 hours the lower flow of weaker sewage at night will permit the sludge to become more thoroughly activated than during the day-time and in effect accomplish the end sought in the re-aeration of the sludge by treatment in separate tanks. Similarly on Saturday afternoons, Sundays and holidays the sludge may be revived by appropriate treatment. This result is obtained in practice and has been very noticeable and beneficial in some cases.

### Peculiarities of Floc.

The little sponge-like aggregations of fine suspended and colloidal matters have no regularity of structure but are merely masses of independent particles held together by slight forces of attraction. They are of great size in relation to the weight of the solids composing them. The forces by which the particles are held together are so slight that the sludge must not be very vigorously agitated or the floc will be broken up. Hence it is necessary to avoid intense agitation in aeration tanks and to induce as little violent agitation as practicable when pumping and otherwise handling the sludge or the sewage after the sludge has been introduced into it.

The character of the floc varies greatly under different conditions. That produced by thoroughly aerating sewage for such a period of time and under sufficiently favorable conditions as to produce a highly purified effluent will usually be of a golden-brown color, relatively compact and heavy, and will settle with surprising rapidity. On the other hand, under-aeration will produce a light, voluminous floc which will not settle as rapidly and which will form a very voluminous sludge of high water content and correspondingly difficult to handle. Under-aeration may be due to furnishing too little air or too short a period of aeration due to crowding too great a volume of sewage through tanks provided with the proper air supply and period of aeration for a smaller quantity of sewage. The effect of low temperature is similar to that of under-aeration and in northern climates there is usually greater difficulty in producing a good sludge in winter than during other seasons. Such may be caused temporarily by the introduction into the sewers of cold water from melting snow. An activated sludge plant should be designed with an adequate factor of safety to meet such conditions.

It is just as important to avoid over-aeration, for this results in a resolution of the floc into colloidal matter with a consequent poor effluent.

The condition of the floc is very dependent upon the sedimentation process. If the sludge is allowed to remain too long without air it loses its activity and becomes septic. It is therefore important to provide for the removal of the sludge from the sedimentation tanks as promptly as is consistent with the proper concentration—in fact, the extent of concentration is limited by the need of maintaining the sludge in good condition.

### Durability of Diffuser Plates.

During the early tests porous plates used as air diffusers became more or less disintegrated within a relatively short period of time. In other cases such plates became so seriously clogged that the pressure necessary to force the required quantity of air through them, became prohibitively great. This was due in part to impurities in the air and in part to rust or other material from the plate holders, which gradually sealed the pores of the plates. At Houston, Mr. Fugate has found that porous plates clogged with rust can be cleaned by emersing them in hydrochloric acid at 98°C.

Improvements in the manufacture of plates, appear to have overcome danger of disintegration, and experience during the past three years has demonstrated that it is practicable to so purify the air and construct the plate holders as to avoid danger of clogging within a short time. The period covered by this experience, however, is too short to show how long a life such plates will have. However, in view of the fact that after continuous use for a period of about two years there is no marked increase in the pressure required to drive the air through the plates, the assumption seems to be justified that the plates will have a useful life of a number of years—certainly as many as five years and possibly a very much longer time.

It should be a source of satisfaction that so many of the causes of trouble with the diffuser plates have been discovered and means devised for remedying them. It is important, however, in designing activated sludge plants in which diffuser plates are to be used, to give very careful consideration to the manner of setting the plates and of cleansing the air.

### Preparatory Treatment by Fine Screening.

A very important advance has been made by demonstrating that it is possible to remove sufficient of the heavy and coarse solids of strong municipal sewage by means of grit chambers and fine screens, to prevent the accumulation of deposits upon diffuser plates which are supplied with air at the rate of 1 cu ft. per minute per square foot of plate area. This assures the successful operation of aeration tanks which prior to this demonstration was open to some question in cities where there is a very large portion of heavy setting solids.

There is opportunity for further investigation to determine whether the quantity of air required can be materially further decreased by finer screening, than that which has already been employed. This would appear to be a promising field for study.

In some cases—particularly where industrial wastes, such as those from tanneries and packing houses are present—the advisability of sedimentation as a means of preparing the wastes for aeration, is worthy of careful consideration. Some such wastes contain very large quantities of coarse and heavy suspended matter, and it is possible, and in some cases probable, that preparatory sedimentation may result in a substantial saving in air and may possibly also be so important as to make the process practical where without such preparatory treatment it might prove impractical.

### Sedimentation—Removing Floc.

Obviously it is necessary to remove the floc in order to produce a satisfactory effluent—it would be folly after having gone to the expense necessary to form the floc, to allow it to escape with the effluent and thus nullify the work done in the first stage of the process.

The character of floc—whether of light weight and voluminous, due to under-aeration or low temperature, or heavy and compact, as a result of thorough aeration under favourable conditions, has an important, if not vital, effect upon the sedimentation process. If the floc is light and voluminous it settles less rapidly, is more easily carried over the weirs in the effluent, and, most important of all, it fails to consolidate and becomes compact as it accumulates in the tank. Generally a well-activated sludge settles very rapidly and forms a relatively compact or dense sludge.

A good floc may form a sludge containing as much as 3 per cent solids and readily forms one of a 2 per cent, while a light, fluffy floc will often produce a sludge of one per cent and sometimes of only ½ per cent solids. The difference between sludges from under-aerated and well-aerated sewage is readily appreciated when the volumes of sludge to be handled are considered. The volumes which commonly occur, based upon a uniform quantity of suspended solids, are given in Table 1.

TABLE I—RELATION OF VOLUME OF SLUGE TO PROPORTION OF TOTAL SOLIDS.

(Original sludge 2% total solids; dissolved solids 800 p. p. m.)

| Water in sludge, %. | Total solids in sludge, %. | Suspended solids in sludge, %. | Relative volumes of sludges of different densities, %. | Volume of sludge to be returned to afford uniform quantity of suspended solids, gal. per M. G. sewage. | Volume of sludge to be wasted. Gal. per M. G. sewage. |
|---|---|---|---|---|---|
| 99.5 | 0.5 | 0.42 | 100 | 909,090 | 68,200 |
| 99.0 | 1.0 | 0.92 | 46 | 418,000 | 31,400 |
| 98.5 | 1.5 | 1.42 | 30 | 273,000 | 20,500 |
| 98.0 | 2.0 | 1.92 | 22 | 200 000 | 15,000 |
| 97.5 | 2.5 | 2.42 | 17 | 155,000 | 11,600 |
| 97.0 | 3.0 | 2.92 | 14 | 127,000 | 9,500 |

The volumes of sludge to be returned and wasted, as indicated by Table 1, are based upon the assumption that these volumes will be equivalent to 20 per cent and 1.5 per cent, respectively, of the sewage treated when the sludge contains 2 per cent total solids.

The importance of providing a relatively dense sludge is obvious from these data. If 20 per cent of sludge containing 2 per cent solids be required, for the successful treatment of the sewage in the aeration tanks, and if for any reason the density of the sludge is suddenly changed to 0.5 per cent solids, the volume which must be pumped into the sewage, to furnish the same quantity of suspended solids, will be increased from 200,000 to 900,000 gal. per million gallons of sewage to be treated, and all portions of the plant devoted to aeration, sedimentation and sludge return, must have capacities for this greater quantity, if the density be permitted to fall to this extent. Similarly, were it assumed that sludge having 0.5 per cent solids can be dewatered with equal facility to that having 2 per cent solids, equipment must be provided for handling 68,200 gal. of thin sludge per million gallons of sewage, instead of 15,000 gal. of normal sludge containing 2.0 per cent solids. Furthermore, the indications are that thin under-aerated sludge is not as easily dewatered as normal well-aerated sludge. From the foregoing discussion it is clear that the success of the activated sludge process depends in large measure upon the production of a good floc and its efficient removal. So important is this phase of the treatment that it may well prove the controlling feature, and it may therefore be necessary to operate the plant primarily for the production of a good floc by providing such quantity of air and period of aeration as may be required for this purpose even though the quality effiuent produced be better than necessary.

### Requirements in Proportioning Sedimentation Tank.

In proportioning sedimention tanks, four requirements should be kept in mind:

1. Opportunity must be afforded between the point of entrance and the point of exit, for the floc to settle sufficiently to prevent its beng carried out of the tank with the effiuent.

2. The rate of sludge withdrawal must be such as to retard the travel of the floc enough to permit it to consolidate and form a relatively dense sludge.

3. There must be provision for drawing the sludge with sufficient rapidity to prevent its being delayed in passage to such an extent that it will undergo septic action which will render it less suitable for the treatment of the incoming sewage and particularly unfavorable for dewatering by methods now in use.

4. There must be sufficient tank capacity to provide space for the accumulation of the floc, which varies greatly from time to time during the day, according to the variation in the strength of the sewage, as well as to other conditions, and also for the accumulation of the abnormally voluminous floc during the periods of cold weather or under-aeration, neither of which can be entirely counteracted or avoided.

As stated by Mr. Hatton, the proposed Milwaukee sedimentation tanks have been designed to receive aeration tank liquor at a rate sufficient to produce 1,600 gal. of effluent per 24 hours per square foot of gross internal tank area at times of maximum flow. The average rate of flow in dry weather will be about 830 gal. per square foot. In the demonstration plant the sedimentation tanks have received as much as 2,000 gal. of aeration tank liquor for substantial periods of time during which the effluent was satisfactory. The more conservative allowance for design, was adopted in order to provide for contingencies, such as light fluffy sludge and changes in volume and quality of sewage. Some of these conditions may be coincident and last for a substantial length of time as for example in the spring when snow is melting, the flow of sewage is high and its temperature is low.

Tests indicate that the floc from municipal sewage and from some industrial wastes, may be concentrated readily to a sludge containing 2 per cent, and under favorable conditions possibly as high as 3 per cent solids. To secure a greater concentration requires storage for so long a time that there is a danger of septic action with its attendant evils. The safe limit of such storage may perhaps be taken at 6 hours, until such time as more data bearing upon this specific point become available.

### Sludge Lagoons.

One of the most interesting developments is the disposal of sludge by pumping it into lagoons at Houston, Tex.

At the South Side Plant, which was started in August, 1918, all of the sludge produced up to the time this plant was visited by the writer in July, 1919, had been pumped into one lagoon which was about 300 ft. long, 100 ft. wide and 7 ft. deep, with side slopes of about 1 on 1½. At that time there was no offensive odor from this lagoon. There was, however, the characteristic odor of algae, which appeared to be growing in considerable quantities. No water had been drawn off from the lagoon, the supernatant water was clear, many gas bubbles were being given off, and some sludge was being carried to the surface by the gas bubbles, but immediately subsided. There was no floating sludge.

At the North Side Plant, where the sludge has been run into three lagoons, conditions were substantially the same.

### Sludge Dewatering.

Perhaps the darkest spot in the entire process of activated sludge treatment is that of sludge dewatering, which has been studied at the Packingtown, Houston and Worcester plants, and particularly by investigations covering a period of several years at the Milwaukee testing station. Notwithstanding all of the investigational work thus far done, this problem cannot be said to have been satisfactorily solved at the present time.

It has been repeatedly demonstrated that well-activated sludge can be dewatered more advantageously than an under-aerated or a stale septic sludge. It is accordingly necessary to so operate the plant, insofar as practicable, to avoid under-aeration, prolonged storage which tends to cause septic action, and probably also over-aeration which tends to resolve the floc into its colloidal condition. It is probable that the plant must be operated with a view to producing the sludge in a condition to be most readily dewatered, although there is a promise that poor sludge can be conditioned so as to be successfully dewatered.

One phase of the magnitude of the sludge disposal problem may be readily appreciated by a comparison of the nominal volumes of sludge produced by the several processes of sewage treatment now in use, Table II.

While it is recognized that the volume of sludge produced by any of these processes will vary materially according to the local conditions, and particularly to the proportion of solid matter removed from the sewage, the activated sludge process, under all conditions, is likely to produce a very much greater volume of sludge than any other process.

TABLE II—NOMINAL VOLUME OF SLUDGE PRODUCED BY DIFFERENT PROCESSES OF SEWAGE TREATMENT.

| Treatment Process. | Nominal volume of sludge, gal. per mil gal. of sewage treated. | Proportion of solids in sludge. | Specific gravity of sludge. | Weight of dry solids in sludge, lb. per mil. gal. of sewage treated. |
|---|---|---|---|---|
| Activated sludge | 10,000 | 2.00 | 1.005 | 1,675 |
| Chemical precipitation | 5,000 | 7.50 | 1.040 | 3,250 |
| Sedimentation | 2,500 | 5.00 | 1.020 | 1,060 |
| Septic tank | 500 | 5.00 | 1.010 | 220 |
| Imhoff tank | 500 | 15.00 | 1.070 | 670 |
| Trickling filter—humus tank. | 500 | 7.50 | 1.025 | 320 |

For the dewatering of activated sludge consideration may be given to the use of four types of machines—the plate or standard filter press, the squeeze press commonly known as the Worthington or Berrigan press, the Schaefer-ter-Meer centrifuge and the Besco-ter-Meer centrifuge.

### Acidification of Sludge.

Activated sludge is normally slightly alkaline and it has been found that its natural slimy characteristics can be counteracted in a measure by acidification. The quantity of acid required will vary according to conditions, but in general, if sulphuric acid is used it may be taken at about 0.12 per cent by volume of the sludge to be dewatered. If it be assumed that the waste sludge will be equivalent to 1.5 per cent of the sewage treated, or 15,000 gal. per million gallons of sewage, the quantity of sulphuric acid required, upon this basis will be about 1.2 gal per thousand gallons of sludge., equivalent to 270 lb. of commercial sulphuric acid per million gallons of sewage. At 1 ct. per pound, the cost of acid will be about $2.70 per million gallons of sewage treated.

The cost of acid may offset in part, or perhaps wholly, by an increase in ammonia content of the dried sludge. This is because of the neutralization of the alkalis with acid, after which heating in the drier does not drive off the nitrogen in the form of ammonia, as is the case when unstable nitrogenous compounds are heated in the presence of alkalis. The gain in ammonia, due to acidification, while varying in different sludges, may be taken at about 12 per cent.

There is likely to be another apparent increase in the ammonia content of the drier sludge, due to the effect of pressing, by which a substantial proportion of the solids in the sludge pass away in the form of press liquor. The proportion of nitrogen in these solids is somewhat lower than that in the suspended matter due to the large proporton of colloids high in nitrogen in the latter. The removal of the dissolved solids, therefore, results in an increase in the proportion of nitrogen in the dry solids of the original liquid sludge.

The effect of the apparent increases due to acidification and to pressing, when applied to the dry sludge containing 10 per cent moisture and computing the value of the sludge at $4 per unit, are shown in Table III.

It therefore appears that there is a theoretical increase in value of $3.62 per million gallons of sewage, due to acidification. If the price be taken at $2 instead

TABLE III—ESTIMATE OF QUANTITY AND PRICE OF FERTILIZER FROM STRONG MUNICIPAL SEWAGE.*

| | | |
|---|---|---|
| Volume of sludge, per m. g. sewage | 15,000 gal. | |
| Proportion of dry solids | 2% | |
| Weight of dry solids per m. g. sewage | 2,500 lb. | |
| Weight fertilizer with 10% moisture | 2,780 lb. equals 1.39 tons | |
| Proportion of ammonia in dried unacidified sludge containing 10% moisture (6% ammonia on dry basis) | 5.4% | |
| Increase in ammonia, due to acidification | 12.0% | |
| Ammonia in dried acidified sludge | 6.05 | |
| Increase in ammonia due to pressing | 9.0% | |
| Ammonia in dried acidified press cake | 6.59 | |
| Price per unit of ammonia | $4.00 | |
| Value per mil. gal. of sewage— | | |
| Fertilized—nominal—unacidified, unpressed, dried | $30.02 | |
| Fertilized—nominal—acidified, unpressed, dried | $33.64 | |
| Difference, due to acidification | | $3.62 |
| Fertilizer—acidified, pressed, dried | $36.64 | |
| Difference due to pressing | | $3.00 |

of $4, per unit of ammonia, the difference would be but $1.80—hardly enough to pay for the acid.

Present indications are that the return from the sale of fertilizer will partially, and perhaps wholly, offset the cost of dewatering and drying the sludge, but that there will probably be no surplus applicable to the operation of other features of the plant.

### Advantages and Opportunities for Improvement in Process

There are two very important advantages of the activated sludge process—the production of a well-purified effluent of attractive appearance, and the complete disposal of the sludge. These advantages are well worth striving for. At present it would seem that this process is particularly worthy of consideration where such an effluent is desired, and where power may be obtained at moderate cost. Obviously it is an advantage for such a plant to be situated in a district where large quantities of fertilizers are used, thus avoiding the necessity of shipping the sludge long distances.

There appear to be two features which give promise of great improvement, on further investigation—the aeration and agitation of the sewage, and the dewatering of the sludge. It may be that the former can be accomplished by some sort of mechanical agitation accompanied by the use of a small quantity of air to maintain aerobic conditions. This would seem to be more easily applied to a small plant than to a very large one like that at Milwaukee, although if the saving in operating expense is sufficient, the size of the plant would probably not offer an unsurmountable obstacle to the adoption of such a method.

At present the hope of improving the method of dewatering appears to lie in the direction of conditioning the sludge rather than improvement of mechanical appliances, although the latter subject should by no means be neglected.

# Concrete Pipe for Sewers

## Concrete in Widespread Use for Both Sanitary and Storm Sewers—Design and Construction Methods Recommended in Portland Cement Association Bulletin

Concrete pipe, both plain and reinforced, are now being extensively used in all parts of the country for building storm and sanitary sewers. It is not definitely known how early concrete pipe were used for this purpose, but such records as are available indicate that they have been giving excellent service since 1873 in many parts of the continent. Developments in concrete pipe manufacture have kept pace with the progress of the concrete industry and in recent years concrete pipe has been produced on a very large scale.

The early use of concrete pipe was in sewers of larger diameters; in later years improvements in concrete pipe making machinery have made possible the successful manufacture of small sizes which are now equally well received by sewer engineers.

Concrete pipe are now made in all standard sizes from 4 inches up to 108 inches internal diameter. They are capable of sustaining the weight of heavy fill in deep trenches or the loads caused by the passage of heavy vehicles when the sewer is near the surface. Due to their impermeability concrete sewer pipe reduce leakage and infiltration to a minimum.

### Designing the System

Sewerage systems are designed on two general plans—separate and combined. The separate system provides two separate and distinct sewers, one to take care of sanitary sewage including domestic and industrial wastes, and the other to serve as a drain for carrying away such surface water as rain, melting snow and ice, and street flushing water. Combined systems

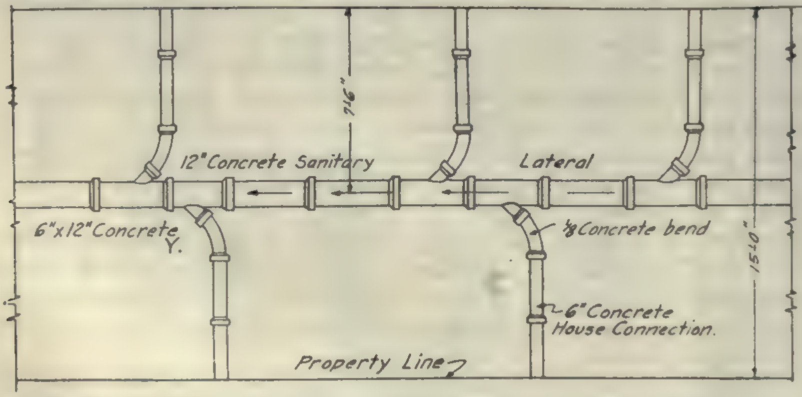


Fig. 1—Special arrangement of 12" sanitary laterals in an alley. Concrete Y's used in preference to T's, thereby increasing the hydraulic efficiency of the line.

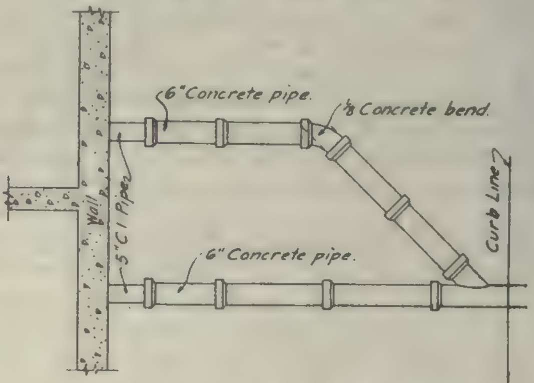


Fig. 2—One method of placing double house connections under a sidewalk.

handle both sanitary sewage and surface waters in one single sewer. Separate systems are used when conditions make it necessary to treat sanitary sewage in disposal plants. Combined systems are installed where the city is located near large bodies of water into which the sewage can be discharged without danger of contaminating the water supply of its own or of other communities. Which system to use in a particular case depends not only upon the sanitary factors above referred to, but also upon questions of the most economical construction, and is properly left to the determination of experienced sanitary engineers.

In designing sewer pipe lines, provision should be made for the future growth of the city so that the important trunk line sewers will never have to be replaced by pipe of larger size. Many cities are frequently compelled to replace at great expense old sewer lines with larger pipe because the city's growth exceeded expectations.

Special attention should be given to regularity of alignment and gradient of sewers. Irregularities not only cause decreased capacity, but also make maintenance difficult and expensive. In hilly country requiring broken grade lines, the cities served by the sewer system should be divided into districts separated by intercepting or trunk sewers, thus permitting uniformity of grade and alignment within each division.

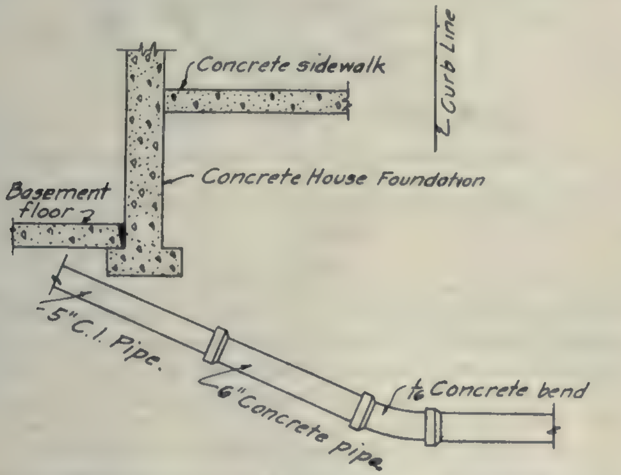


Fig. 3—Method of placing a single house connection under sidewalks. Unnecessary bends should be avoided.

Typical methods of placing house connections are presented in Figures 1, 2, 3, 4. House connections should never be under six inches internal diameter and should be laid as straight as possible and on a minimum grade of 2 per cent (¼ inch per foot). The danger of clogging in smaller pipes is so great that the slightly increased cost of the six-inch connection is justified. Final inspection should be made of each lateral and an accurate record kept of the Y at the lateral and the end of house connection at the property line. Sketches of any change from original plan should be made and recorded. Correct design of details is an important part of sewer construction and helps to reduce the cost of maintenance. Examples of such details are shown in figures 5 to 8 inclusive.

The type of manhole design shown in Fig. 5 is used to avoid unnecessary excavation where a considerable difference in elevation exists between two lines, and to maintain uniform velocity of flow.

All storm water should pass through a catch basin like that shown in Fig. 8 before entering the sewer in order to remove silt and other material that would otherwise clog the sewer.

A lamp hole, is, as its name implies, an opening through which a lantern may be let down into the sewer line for the purpose of locating obstructions. Such holes are installed by some engineers where manholes are more than 400 ft. apart.

### Construction Methods

The recommended practice for laying sewer pipe, adopted by the American Society for Testing Materials in 1919, should be closely followed in order to insure best results. Extracts are given below.

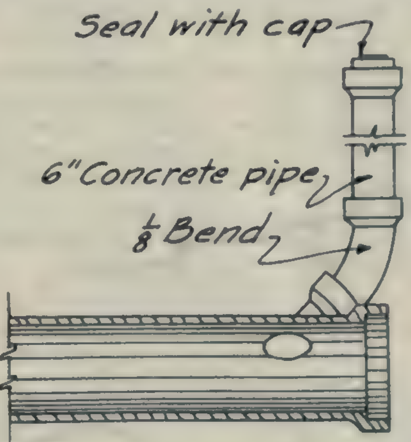


Fig. 4—Typical arrangement of deep house connection to place the weight of the riser on the bend.

"The foundations in the trench should be formed to prevent any subsequent settlement and thereby possibly an excessive pressure and consequent rupture of the pipe.

"If the foundation is rock, an equalizing bed of concrete or sand well compacted should be placed upon the rock. The thickness of these beds should be not less than 4 inches. Pipe should be laid in these beds so that at least the lower third of each pipe is supported its entire length.

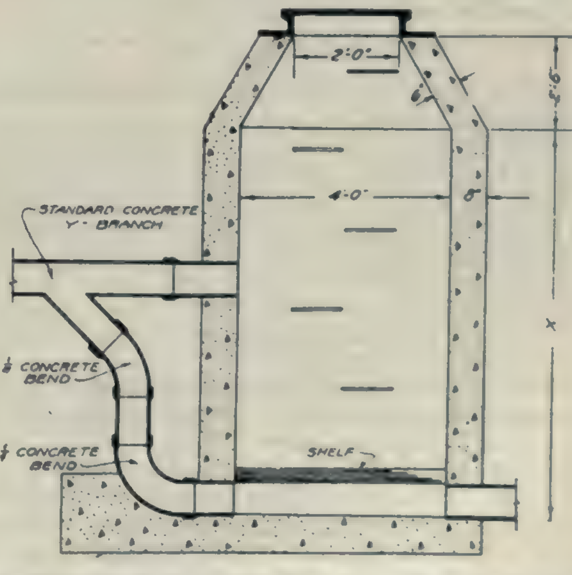


Fig. 5—Concrete manhole with drop connections used to avoid unnecessary excavation where there is considerable elevation between connecting lines, and to maintain uniform velocity and flow throughout the system.

"If the foundation is good firm earth, the earth should be pared or molded to give a full support to the lower third of each pipe, and, if necessary to secure a proper bearing for the pipe, a layer of concrete, fine gravel or suitable material should be placed. The same means of securing a firm foundation should be adopted in case the excavation has been made deeper than necessary.

'If there is no good natural foundation, the pipe should be laid in concrete cradle supported on a masonry foundation carried to a soil of satisfastory bearing power or supported on a structure designed to carry the weight of pipe and its load to a firm bearing.

"Trenches should be kept free from water until the material in the joints and masonry has sufficiently hardened.

"To protect pipe from unusual stresses all work should preferably be done in open trenches.

"Pipe lines should be placed at a sufficient depth below the surface of the street to avoid dangerous pressure or impact. When this is not possible special reinforcement should be provided.

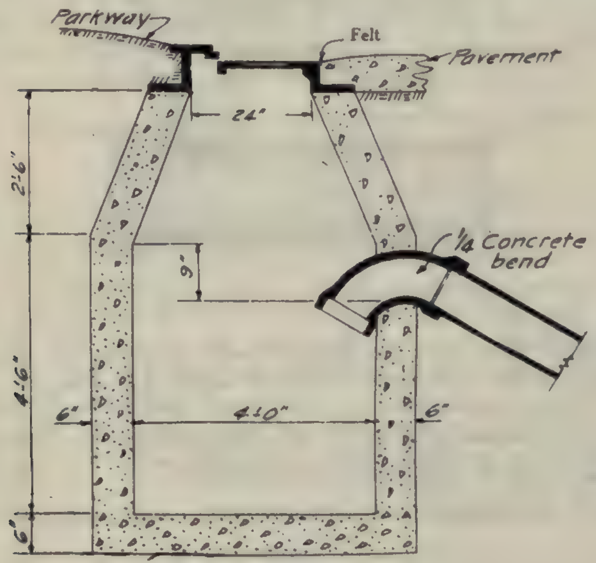


Fig. 6—Typical catch basin.

"Trenches should be only of sufficient width to provide a free working space on each side of the pipe, preferably not over one-third of the nominal diameter and never less than four inches, according to the size of the pipe and the character of the ground; but in every case there should be sufficient space between the pipe and the sides of the trench to make it possible to thoroughly ram the back-filling around the pipe and to secure tight joints.

"The laying of pipe in finished trenches should commence at the lowest point, so that the spigot ends point in the direction of flow.

"All pipe should be laid with ends abutting and true to line and grade. They should be fitted and matched so that when laid in the work they will form a sewer with a smooth and uniform invert.

"It is necessary to use all possible care when shoving the pipe together, so that the joints will not be unnecessarily large.

"Sockets should be carefully cleaned before pipe is lowered into trenches. The pipe should be lowered so as to avoid unnecessary handling in the trench.

"The pipe should be set firmly to line and grade and the joints carefully adjusted and filled with the jointing material.

"Joints should be made in the following manner: A closely twisted hemp or oakum gasket of suitable diameter, in no case less than ¾ inches, and in one piece of sufficient length to pass around the pipe and lap at the top, should be solidly rammed into the annular spaces between pipe with a suitable calking tool. When cement joints are used, the gasket should first be saturated with neat cement grout. The remainder of the space should then be completely filled with the jointing materials.

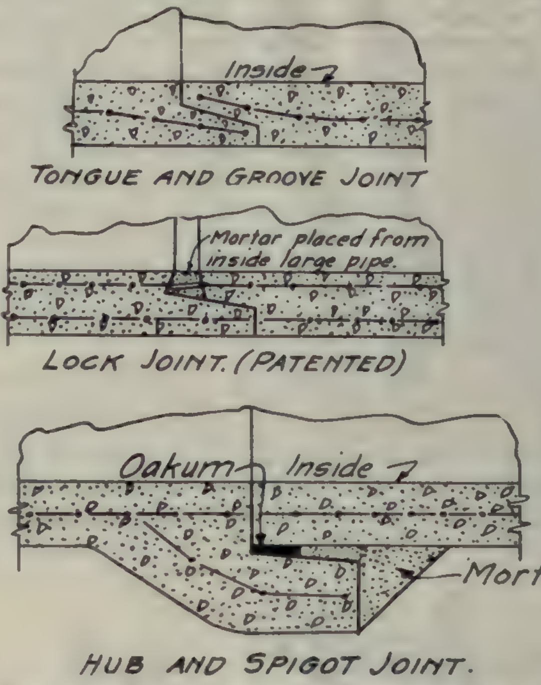


Fig. 7—Joints commonly used in concrete pipe sewers.

"All trenches and excavations should be backfilled immediately after the pipe is laid therein, unless other protection of the pipe line is directed. The back-filling material should be selected and deposited with special reference to the future safety of the pipe. Clean earth, sand or rock dust should be solidly tamped about the pipe up to a level at least 2 feet above the top of the pipe. This material should be carefully deposited in uniform layers. Unless otherwise permitted, each layer should be carefully and solidly tamped or rammed with proper tools so as not to disturb or injure the pipe line.

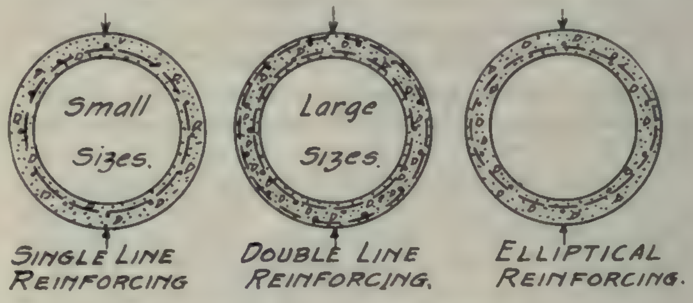


Fig. 8—Methods of reinforcing concrete pipe.

"Puddling or water flooding for consolidating the backfilling is recommended only for sandy and gravelly materials. If this method is used, the first flooding should be applied after the backfilling has been compacted by tamping up to 2 feet above the top of the pipe, and the second flooding during or after the subsequent filling of the trench. An excess of water should be avoided, in order to prevent disturbance of the earth under and around the pipe and also to prevent an undue excess of pressure upon them.

"Walking or working on the completed sewer, except as may be necessary in tamping or backfilling should not be permitted until the trench has been backfilled to a height of at least 2 feet over the top of the pipe.

"The filling of the trench should be carried on simultaneously on both sides of the pipe in such a manner that injurious side pressures do not occur.

### Manufacture of Concrete Pipe

Plain concrete sewer pipes are usually manufactured by machine in standard sizes ranging from 4 inches to 42 inches internal diameter. Concrete of semi-dry consistency is used which is thoroughly compacted in molds under pressure. The correct consistency has been obtained when web-like markings appear on the outer surface of the pipe upon removal from the molds. After removal from the molds the pipes are placed in a saturated steam or water-spray curing room, for a sufficient period, to insure great strength and low absorption.

Machine-made concrete pipe are of true cylindrical form with a smooth interior surface and offer excellent advantages for house connections, main lateral sewers and intercepting sewers. All necessary bends, Y's and other specials, of the same excellent quality, can be secured wherever concrete pipe are made.

Reinforced concrete pipe are made in standard internal diameters of from 12 to 108 inches and in lengths from 2½ to 6 feet. The types of joints commonly used are shown in Fig. 9. Three methods of placing the reinforcement are illustrated in Fig. 10. Concrete pipe may be inspected before being placed in the trench and the joints can be easily made and inspected after the pipe are in place.

### Specifications

The American Society for Testing Materials adopted standard specifications for plain concrete sewer pipe June, 1920. Engineers are urged to specify pipe that meet these specifications.

## Mainly Constructional

**East and West—From Coast to Coast**

The City Council of Hull, P. Q., will shortly present a bylaw to the people, authorizing the expenditure of $540,000 on several badly needed civic improvement works.

It has been announced that the Marconi Wireless Telegraph Co. of Canada, Limited, propose erecting a new wireless station at Laprairie, P. Q., which, when completed, will be the largest station of this kind in the world.

The Essex Provision Company, Ltd., of Windsor, Ont., recently awarded the contract for their new building to Messrs. P. H. Secord & Sons Construction Company, of Brantford, Ont., The building will be constructed of steel and concrete and will cost between $500,000 and $600,000 when completed.

It has been announced that a fifteen-storey addition to the Mossop Hotel at Toronto will be erected soon. The new building will have a 40-ft. frontage on Yonge Street with a depth of 80 feet and will provide 140 rooms, each equipped with bath. The estimated cost of this building is $750,000.

A new company, the Feldspar Glass Company, Limited, will shortly commence the construction of a factory at Oshawa Ont. The plant will be built in units, the first to be 60 ft. x 160 ft., and will employ 50 men. They will manufacture high-grade glass and by-products, and expect to be in operation in a few months.

Messrs. Wallace Barnes & Company, of Bristol, Conn., have purchased the plant of the National Machinery & Supply Company, at Hamilton, and will shortly commence the manufacture of their line of screw machine products, springs, etc. This Canadian branch is capitalized at $300,000 and will employ about 150 men.

The new Lieutenant-Governor of Ontario, Lt.-Col. Henry Cockshutt, officiated at the laying of the corner stone of the Orillia Soldiers' Memorial Hospital, Ont., recently. The new building, with equipment, will involve an expenditure in the neighborhood of $200,000, and, it is expected, will be ready for occupation in the spring.

Representatives of the Detroit and Windsor promoters of the proposed International Memorial Bridge over the Detroit River, between these two cities, discussed the scale of $15,000,0000 worth of bonds to finance the construction of this bridge, before the Michigan Public Utilities Commission. at Detroit recently. The promoters are endeavoring to secure authorization for the sale of these bonds.

As the result of a conference between Hon. Gideon Robertson, Minister of Labor, and representatives of the employees on the Welland Canal construction work the Department of Labor will arrange the schedule of wages and working conditions to apply to all sections of the work. This situation follows the failure of the contractors and employees to reach a settlement during the recent conference held in St. Catharines.

All work on public highways throughout the province of Alberta has been shut down. This action has been taken for the purpose of taking stock and finding out just what has been done and what remains to be done. A great deal of highway work has been going on in different parts of the province this season and this work has been so extensive and scattered that it was thought best to call a halt so that the new government would know just where they were at on their road program.

The Municipal Council of Penticton, B. C., recently gave the provincial government until November 15 to secure an option on a site on Main street for the erection of government offices, with a request for an assurance that if the site is accepted the building operations will commence by August 1, 1922. It is understood the government proposes to remove the offices for the district from Fairview to Penticton and the municipality has reserved this site for that purpose.

### Personal

Mr. A. G. Stephens recently resigned from the council, at Walkerville, Ont., to accept the position of superintendent of parks and boulevards for the town.

Messrs. Henry John Burden and G. Roper Gouinlock, architects, of Toronto, have formed a partnership under the firm name of Burden & Gouinlock, and have opened offices at 101 King St. west.

Mr. D. W. Hays, consulting engineer of Spokane, Washington, has accepted the appointment of supervising engineer of the United Irrigation District, of Alberta. Mr. Hays was at one time general manager of the Canada Land & Irrigation Company, Medicine Hat District.

Mr. John Callaghan, of Calgary, Alberta, who at one time held the position of chief engineer of construction for the Pacific and Great Eastern Railway but who has of late been connected with the Canadian Pacific Railway Company, has been appointed Deputy Minister of Railways and Telephones. Mr. Callaighan will also act as manger of the Alberta Government railway lines.

# CONSTRUCTIONAL ACTIVITY

## Period of September 21 to September 27, 1921

***Dominion Wide Service Exclusive to "Contract Record & Engineering Review"***

### Waterworks, Sewerage and Roadways

**Dundas, Ont.**

Alfred Broad, Chrm. Bd. of Works, will receive tenders, no closing date set, for concrete boulevards on one street for Town. Plans with C. R. Murdock, Engr.

**Hamilton, Ont.**

Suburban Area Cmsn., Court House, plan construction of road Burlington Beach.

City Council will construct asphalt pavement, concrete sidewalks and curbs on several streets at estimated cost of $141,000. E. R. Gray, Engr.

City Council contemplate repairs to James St. reservoir to cost $15,000.

**Montreal, Que.**

Construction of sewers in several streets is planned by City Council.

Construction of sidewalks on several streets is contemplated by City. E. A. Doucet, Engr.

**Toronto, Ont.**

F. Barber, Engr., 40 Jarvis St., has plans and will receive tenders until Oct. 1st for construction of concrete sidewalks, paving, and for grading on several streets for York Tp. Council.

York Twp. Council plan construction of 6 in. watermains in several streets. W. A. Clarke, clerk, 40 Jarvis St., Toronto.

#### CONTRACTS AWARDED

**Montreal, Que.**

Additional contracts for electric pumping station for City are: Vault doors, Ross & Greig, 400 St. James St.; steel, Phoenix Bridge Co., 83 Colborne St.; over cranes, Dominion Bridge Co., Dominion Station, Lachine; roofing and Kalemein doors, McFarlane-Douglas Co., Ltd., 34A Dorchester St. W.; plumbing and heating, J. Ballantyne, 163 Nazareth St.; valves and pipes, Dominion Engineering Works, Lachine; millwork, Traversy, Ltd., 100B Papineau Ave.; arch. and orn. iron, John Watson & Sons, Ltd., 167 Wellington St.; granite, Stanstead Granite Co., Stanstead, Que.; metal sash, Denis Wire & Iron Works, 1328 City Hall Ave.

**Osgoode, Ont.**

General contract for waterbound macadam road for Carleton County Council is awarded to The Farmers Grove Construction Co., care of Patterson & Byrne, Engrs., 71½ Sparks St., Ottawa.

**Ottawa, Ont.**

General contract for construction of asphalt pavement costing $15,000 for City is awarded to O'Leary's, Ltd., Bank National Bldg.

**St. Lambert, Que.**

Council awarded contract for reinforced concrete pipe costinfi $16,600 to Independent Concrete Pipe Co., Ltd., Huron St., Woodstock, Ont.

**St. Ours, Que.**

General contract for gravelling roads at cost of $10,094 for Municipality is awarded to J. P. Lachapelle and R. Potvin, St. Ours.

### Railroads, Bridges and Wharves

**Cowichan Bay, B.C.**

R. C. Desrochers, Secy. Dept. Pub. Works, Dom. Govt., Ottawa, will receive tenders until Oct. 21st for construction of wharf. Plans at offices of Dept., Dist. Engr., Victoria, and at Post Office, Cowichan Bay. Accepted cheque for 10 per cent. of tender required. Tenders to be made out on forms supplied.

**Notre Dame des Sept Douleurs, Que.**

R. C. Desrochers, Secy. Dept. Pub. Works, Dom. Govt., Ottawa, will receive tenders until Oct. 12th for construction of extension to wharf. Plans with Dept., offices of Dist. Engr., Post Office Bldg., Quebec, Rimouski, Que., and Post Office of Notre Dame des Sept Douleurs. Accepted cheque for 10 per cent. of tender required.

**Ottawa, Ont.**

Ottawa Improvement Cmsn., Castle Bldg., contemplate construction of several bridges. A Stuart, Engr.

**Toronto, Ont.**

F. Barber, Engr., 40 Jarvis St., has plans and will receive tenders until Oct. 1st for construction of reinforced concrete arch and also concrete culvert for Etobicoke Twp. Council.

**Welland, Ont.**

Construction of bridge across Welland Canal is contemplated by Dom. Govt., Dept. Pub. Works.

#### CONTRACTS AWARDED

**East Angus, Que.**

Steel contract at $182,000 for steel and concrete bridge for Municipal Council is awarded to MacKinnon Steel Co., Ltd., Drummond Rd., Sherbrooke, Que.

**Springfield, Man.**

Samson & Collins, 601 Main St., Winnipeg, have general contract for construction of reinforced concrete bridge.

### Public Buildings, Churches and Schools

**Aylmer, Ont.**

Secord & Murton, architects, Home Bank Bldg., Hamilton, will receive tenders, no closing date set, for erection of hospital to cost $40,000 for East Elgin Hospital Assn. Plans with H. E. Armstrong, secy.

**Edson, Alta.**

Lady Grey Hospital Bd., Ottawa, will repair hospital at Edson, Alta.

**Imperial, Sask.**

Erection of school is planned by Imperial School Bd.

**Niagara Falls, Ont.**

Tenders will be called shortly for erection of police station to cost $17,000 for City. W. J. Seymour, clerk.

**Paris, Ont.**

Erection of addition to high school costing $15,000 is contemplated by High School Bd. C. B. Barker, secy.

**St. Catharines, Ont.**

Thos. H. Wiley, architect, 128 St. Paul St., has plans and will receive tenders until Oct. 3rd for erection of school for Bd. of Education, 13 Welland Ave.

**The Pas, Man.**

Erection of church at cost of $20,000 is contemplated by R. C. Church.

**Timmins, Ont.**

Ellis & Ellis, architects, Manning Chambers, Toronto, have prepared plans for addition to school for School Bd. H. E. Montgomery, secy., Timmins.

**Toronto, Ont.**

S. B. Coon & Son, architects, 4 St. Thomas St., have plans and will receive tenders until Oct. 3rd for erection of school costing $150,000 for S. S. No. 26, York Twp.

**Walkerville, Ont.**

Wm. Thorburn, secy. School Bd., 83 Devonshire Rd., will receive tenders until Oct. 12th for erection of high school to cost $450,000. Plans with J. C. Pennington and J. R. Boyde, architects, Bartlett Bldg., Windsor, Ont. Accepted cheque for 5 per cent. of tender required.

#### CONTRACTS AWARDED

**Beausejour, Man.**

General contract for erection of addition to school for Beausejour S.D. is placed with D. McAllister, Beausejour.

**Carievale, Sask.**

John Griffin, Carnduff, Sask., has general contract erecting a school for Thunder Creek S.D. No. 262.

**Dorion, Ont.**

C. E. Duffield, 1108 Donald St., Fort William, has general contract erecting school costing $20,000 for Cosn. School Bd., Thunder Bay Dist.

**Edmonton, Alta.**

A. J. MacDonald, 10209 100 Ave., has general contract erecting temporary school for School Bd.

**Fort McMurray, Alta.**

Carpentry contract for hospital for Dr. Ings, Fort McMurray, is awarded to W. E. Smith.

**Fredericton, N. B.**

Tenders will be called for erection of Synod House for Christ Church Cathedral.

**High Prairie, Alta.**

Gander and Clarke, Peace River, have general contract erecting school costing $10,000 for High Prairie S.D. No. 36.

**Montreal, Que.**

Electrical contract for chapel for Parish de la Nativite, 306 Desery St., is placed with Vallee Hamelin, 1867 St. James St.

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Vol. 35 Toronto, October 5, 1921 No. 40

## *Labor's Production Improved but Not Up To Standard. What is Labor's Excuse?*

According to a Montreal contractor, there is a noticeable increase in the amount of work "Labor" is turning out to-day, as compared with a few months ago. This increase, he believes, amounts to 20 per cent.

He adds, however, that production is not yet nearly as high as in pre-war days.

What have labor men to say in answer to this charge? What have bricklayers, for example, to say to the statement that whereas they were laying 770 bricks a day—or less—they are now doing 900 on an average? Non-union men, this contractor says, are laying as high as 1,700 a day.

What excuse can any able-bodied man give for shirking his work—for right down laziness? Indeed in many cases, it is worse than laziness—it is an unworthy, deliberate attempt to enhance the cost of the work, simply because so-called "Capital" pays for it.

Everybody wants to see the Canadian workman live with his family—in comfort. But Canada, as yet—and we hope it will always remain so—is a country where everybody must work for what he gets. The advantage of this Canada of ours is simply that it repays us well for our labors. "Labor," looking on from the outside, may sometimes think that "Capital" does not work as hard or as long hours. This, with a very few exceptions, is entirely erroneous.

Every man, in whatever trade or industry, and in whatever capacity in that trade or industry, must, in doing his duty, do a day's work every day.

Labor must not forget that, in the long run, it pays its own wages. Unless we produce wealth, in one form or another, we cannot have it—it does not exist for us to have. The unemployed, the shirker, or the striker, may delude himself that he is putting one over on somebody. If he does, it is, in the last analysis, his fellow-laborer, who is working to produce what he consumes in his idleness. Work and production and wealth are so intimately tied in together that they cannot be separated—they cannot exist one without the other.

The spectacle of twenty thousand men without employment is a sad one in a country where things that need doing badly stare one in the face at every turn. Roughly, this is a hundred thousand dollars a day—lost to the men themselves—thrown into the sea. A strike and unemployment fund does not alter the fact any more than insurance replaces fire loss. Every fire is so much wealth gone—for all time. So is every idle day spent by any able-bodied man capable of doing useful work.

Everything considered, Canada, following the war, had a most wonderful opportunity. Well supplied with natural resources in the form of raw materials of various sorts, a keen demand from the outside world, enfeebled competition, capable hardy workmen, and an established reputation—are all these things to go for naught? It looks like it. Our Dominion Government is to-day staking its life on the continuance of a high protective tariff, rendered necessary by the high cost of production at home. We can win wars against the most resourceful, the most scientific and the most fully-prepared nations in the world, but we,ve got to admit that we can't compete with them in commerce. We're too lazy, or inefficient, or both. It's rather a humiliating admission, isn't it?

It is plain, therefore, that Canada's future depends, not on her natural resources, not on her present wealth or prospects, but on her people. Will we work? If so we're due for a prominent place among the nations abroad. Will we shirk? Then our tariff wall must be raised higher and higher and the term Canadian-made" will cease to exist outside our own borders.

Shirk or work? The choice is left with ourselves.

* * *

Large classes in labor have taken their losses by severe wage cuts. Among those which have accepted them have been many skilled crafts which have seen that in the long run wages on the new basis will have a purchasing power equivalent to that when wages were higher.

Certain classes of labor contrast unfavorably, however, with labor as a whole. The time is not far distant when not only that uncertain group known as the "general public" but those sections of it consisting of other classes of workers and farmers will have come to a realization that labor pays its own wages, which are ultimately measured, not in money, but in goods. The money wage only measures the estimated worth to other consumers of the goods produced by the wage earner.

If special labor groups refuse to accept reductions in keeping with the general trend of both wages and prices, the farmers, the makers of shoes and garments and all those classes which supply the necessaries of life to these men for a time at least must give up in the form of unduly high prices a disproportionate share of the food or other goods which they produce in return for transportation, coal and other goods.

## No. 63

# Canada's Engineers—Thomas Tremblay

**So uncertain are the elements of life in municipal engineering circles the world over, that when one meets an engineer who has been the incumbent of office for nearly a quarter of a century, he knows, as a rule, that he stands in the presence of one greater than himself. Such a man is Mr. Thomas Tremblay, city engineer of Sherbrooke, in the Province of Quebec.**

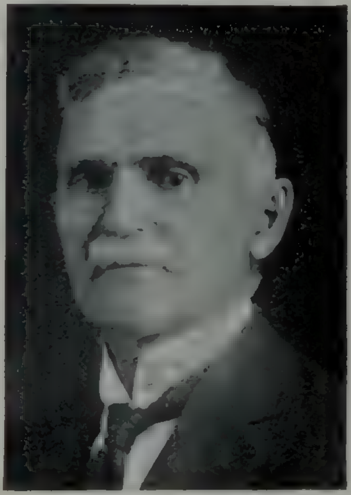
**Thomas Tremblay was appointed city engineer of Sherbrooke twenty-three years ago. While pursuing the even and uneven tenor of the way that falls to the lot of all municipal engineers, he has seen Sherbrooke grow from an ambitious town of eight thousand people to a thriving industrial city of some twenty-five thousand inhabitants.**

**His first venture was at survey work in the North-West, after which he obtained a Government appointment on a similar undertaking in the Province of Quebec. For a period of six years he was engaged in the practice of his profession at Sherbrooke.**

**During the long and honorable term of his present engagement, Mr. Tremblay has had wider experience than falls to the lot of the average town or city engineer, for not only has he had to adapt and increase the various municipal systems to the requirements attendant upon rapid growth, but he has personal charge of all details of the many branches of that municipal development. His experience has thus been broad and varied.**

**In the first place, Mr. Tremblay was engaged specially to take over the water-works system, and he has perhaps concentrated in that field. Fourteen years ago the city of Sherbrooke installed a new water-works system on the Magog River, three miles from the city. The work which Mr. Tremblay was called upon to supervise included a large concrete dam and the erection of a pumping station, with piping to a new reservoir of ten million gallons capacity within the city limits. At the present time another reservoir, with an additional capacity of six million gallons is under construction.**

**Permanent paving was not commenced in Sherbrooke until quite recent years. In four years some five hundred thousand dollars has been expended on this work, and further enterprising plans are in progress.**


Thomas Tremblay

**The expansion of both the industrial and housing sections of the city of Sherbrooke has given Mr. Tremblay considerable activity in the field of sewerage. Sherbrooke has no sewage disposal works, the sewage being emptied into the St. Francis River.**

**Of various undertakings carried out under Mr. Tremblay's supervision, mention may be made of a large concrete dam for the city power plant.**

**Mr. Tremblay pins his faith to Sherbrooke and looks forward with confidence to the greater activities which will ensue upon a return to normal constructional development. He has our best wishes in advance for the Silver Wedding anniversary of his marriage to Sherbrooke.**

## *"Preparedness" in Roadmaking an Essential to Efficiency and Economy*

Anything that tends to economy and efficiency is desirable. Just at the moment, more money is being spent in road building and maintenance than in any other direction. It follows, therefore, that efficiency in this direction is a prime essential. Yet, what do we find in many cases? Specifications are not ready at proper season; contractors have not time in which to make the necessary surveys to enable them to submit proper tenders and the work is held up till the good weather is gone.

There seems to be little reason why work on roadways should not be comenced just as soon in the spring as weather and road conditions will permit. To do this, however, it is necessary that contractors have an opportunity to look the situation over in the Fall. To this end it is essential that tenders should be called toward the end of the previous year, say, in November. This would enable the contractor to make a study of the conditions he would have to meet; to look over the ground; to make an estimate of the cost of material required; to get his equipment in order, repairing where necessary and purchasing new. In a word, we should get away from this unsatisfactory condition where we are always rushing to catch up with the game.

It is difficult to determine just what is the cause of the present unsatisfactory method of calling tenders.. Partly, it seems to be the result of habit and partly that the fiscal year of governments and councils of various sorts, is on or around December 31. If the year were to end two or three months earlier, when the road construction work of the season is brought to a close, would it not be much more satisfactory for everybody? Should we not get much more done in the season and would it not be possible to do it cheaper and more economically?

We asked the opinion of a number of highway officials on this point and are in receipt of an interesting letter from the Commissioner of Highways, Mr. A. W. Campbell. Mr. Campbell makes the suggestion of the fiscal year closing at the end of October or November and touches on a number of other interesting points. His letter, which we are reproducing below, will be read with unusual interest.

Ottawa, September 20, 1921

Editor Contract Record :

I am in receipt of your letter of the 23rd. inst. in which you ask for an expression of views as to the advisability of letting highway contracts in the fall previous to commencement of operations.

No work being carried out under governmental auspices and direction in the different provinces of Canada is requiring perhaps nearly as much organized planning as highway construction and improvement, from inception to completion.

Highway improvements as now demanded by the public have, in point of expenditures required and in diversity of the public interests affected, become so important, that the responsible officials of the different Departments of Highways now find it desirable to give greater attention to the making of surveys on old roads, and to the preparation of careful plans and estimates of costs of making new roads, scientifically, in other words, with a full knowledge of what is to be done. This work of preliminary engineering always requires considerable time—a fact often given as a reason for not preparing information and data necessary to permit of tenders being called and contracts awarded. Consequently it is very desirable to consider ways and means of facilitating prompt execution of the various road construction projects, particularly those yet to be initiated. With this object in view, and at the same time to afford opportunities to the unemployed of the late fall and winter months to work with advantage to themselves, contracting firms, and the public, each provincial Department of Highways should make any necessary arrangements to the end that surveys will be completed, and estimates will be all ready so as to enable contractors to look over the improvements to be undertaken, and make a business-like bid, prior to the award of contracts covering the major portion of the provincial programme of construction in the autumn.

One advantage of this system of procedure is, other things being equal, that bids are lower, because contractors realize that they can assemble plant, equipment and materials during a season of the year when transportation is easier and lower, when labour is more available and often cheaper, and when repairs and spare parts, or on the other hand information as to manufacturers and capacities of equipment, may be secured, so as to avoid the heavy overhead losses usually occurring in connection with the assembling of work-crews and equipment to be employed on projects awarded during the spring or winter months.

Moreover it is reasonable that better work results when plans and estimates have been considered, and contracts awarded well in advance of the date upon which it is desirable that work commence. Adequate inspections of work and materials may then become almost a surety throughout.

Greater competition among contractors might seem to be expected when contracts are let in the fall, because as old contracts are about to be completed, the owners of road-building equipment are anxious as to its disposition. But early evidence that bids are to be received by departments is strong incentive to younger engineers to ally themselves with capital, and submit tenders, especially where full engineering data is available.

It is certainly in the interests of economy, not to say society, that advantage be taken by the different Departments of Highways, of seasonable unemployment, for all phases of road-work. The letting of as many contracts as possible in the autumn and winter preceding a season favourable to the completion of any given type of construction is therefore in accord with public sentiment, and is besides, good business.

In different Federal Departments of Government it has been found desirable to ask each year for a vote for "Surveys and Inspections". This account is used to cover the necessary outlays in making surveys of public works, so as to have full information before appropriations are asked of Parliament, to provide for their execution. In order to facilitate preliminary engineering on provincial highway projects, it may be that a similar account covering the expenses incident thereto, would be of advantage in some of the provinces. Delays arising from Departments being obliged to wait for late sessions of the Legislatures making the appropriations required to finance the carrying out of improvements from beginning to end, would be avoided, as a result.

For a number of reasons, it is preferable, where practicable, to have a provincial fiscal year end at or about the time that the working season ends. Provinces whose fiscal year closes at end of October or November, find, when Legislatures meet early in the year, that necessary appropriations are available enabling Departments to proceed with surveys and inspections well in advance of the proper period for commencement of actual work. A result is that everything is then in readiness for the awarding of contracts at the most favourable time.

I believe that "The Contract Record" is doing a public service in calling attention to the desirability of awarding autumn contracts, and I am pleased to have an opportunity of expressing my views in this connection.

Yours truly,
J. W. Campbell,
Commissioner of Highways.

## Prominent British Engineer Visiting Canada

Mr. Alfred Dryland M. Inst. C. E., county engineer for the county of Middlesex, England, recently arrived in Montreal on a visit to Canada and the United States. Mr. Dryland is one of the leading highway engineers in England and is investigating present highway practices, especially concrete road construction. The appropriation in Middlesex for public works this year is $10,000,000. Much of it is being expended on highway work to provide relief for the unemployed. Mr. Dryland has under construction the longest stretch of concrete paving yet authorized in England.

The enormous increase in motor bus and motor truck traffic in England is providing a new problem for highways in England, and has led Mr. Dryland to undertake a careful study of the results that are being secured on this side of the water.

In addition to being chief engineer for Middlesex County, Mr. Dryland is a fellow of the Institute of Engineers of the British Empire, a fellow of the British Institute of Municipal and County Engineers, a member of the Executive Council of the Instute of Transport, and a past president of the County Surveyors' Society of Great Britain.

# Concrete Arch Bridge of three 250-foot Spans

## The Design, Architectural and Construction Features — Plant arrangement and Operation a Pattern for Bridge Builders of the Future

A high-level concrete arch bridge illustrating many novel and modern features has just been completed across the Monongahela River at Fairmont, W. Va., and is described in the current issue of the Engineering News-Record. The following details are extracted from this article: ........

In developing the plans for the new river crossing the designers at first contemplated building a single huge arch across the channel—a 432-ft. span with two cored-out ribs of 95 ft. rise. This design was abandoned because of foundation conditions and cost. A better solution was found in a three-span design. The War Department required a channel clearance height of 50 ft. on a 200-ft. width, which dictated a 250-ft. arch with 52-ft. rise from a springing-line elevation 33 ft. above pool level. By using side spans of the same length all railroad and street limitations on both banks could be met. This arrangement also placed the end arch abutments against suitable rock ledges.

Equality of span lengths is an important feature of the structural design throughout, resulting in marked economy by allowing the use of forms several times and in some instances as many as six times.

### Subsoil

The geological conditions are typical of coal-mining country. Rock was found about 15 ft. below pool elevation, covered with sand and gravel varying in depth from a few inches to several feet. Shot-drill core borings disclosed sedimentary rocks varying from medium hard shales, limestone, etc., to very hard sandstone. Sufficient holes were drilled for each foundation—especially for the river piers—to determine the condition of the various strata, to make certain that each stratum lay in its natural bed, and that there were no breaks or caverns beneath the top layers.

The west pier was founded on solid sandstone about 11 ft. thick, the sandstone lying on top of a stratum of hard, shaly limestone. In the west abutment sandstone was encountered, while the east abutment was founded on shales and limestones of varying hardness. The piers for the approaches were founded on sandstones and hard shales and, in a few instances, on hard compacted clay.

### Arch Design

The three long spans have two ribs, each 14 ft. wide, spaced 14 ft. apart in the clear, reinforced with 22 1¼-in. bars 8 in. on centers in both top and bottom. These bars are held in place by structural-steel spacer frames, which also strengthen the rib against shearing stresses. There are also shear bars placed at intervals between the spacer frames.

The arches were designed for 150 lb. per sq. ft. on the roadway, and 100 lb. per square foot on the sidewalks. The floor slab and girders under the trolley tracks were designed for 50-ton cars with 25 per cent impact, and under the remainder of the roadway for 150 lb. per square foot or an axle-load of 24,000 lb., with 25 per cent impact.

For slab and girder design the permissible stresses in the concrete were 650 lb. per square inch for compression and 16,000 lb. per square inch tension in the steel; for the arches, 750 lb. per square inch for compression in the concrete, which included temperature stresses for a total range of 50 deg. F.

### Strain-Gage Observations

To obtain greater certainty regarding the stresses in the arch ribs, the designers carried out an extensive program of strain-gage measurements on the arch reinforcing at various points, as well as on the concrete at the crown and haunches of the two arches. These measurements, together with extensive temperature measurements of the interior of the arch concrete, were undertaken primarily to determine the magnitude of temperature stresses. While their data are not available for publication at this time, it can be said that the strain-gage readings show higher stresses in the steel

A Handsome Structure Consisting of three Equal Span Lengths than those calculated by the usual methods of arch design.

Supporting the floor system above the arch ribs are slender transverse walls 16 ft. apart, connected at the top by girders with curved bottom line. Cantilevers cast with this girder section, overhanging 8 ft., support the sidewalks. Each cantilever is tied into both wall and girder with six 1-in. bars, because of notching for a water main and a conduit tunnel. The brackets, shaped to an ellipse from a wall capital to a point from which a curved return of short radius is made to the post unit of the parapet, gives a most solid and at the same time graceful effect.

The floor slabs are continuous over three spans between expansion joints, spaced generally 48 ft. apart and located over transverse walls. The 3-in. slab forming the bottom of the conduit tunnel was cast in short sections off the job and later set in place. The 5-in. slab covering conduit tunnel and water main was cast in place in short sections, for facility of access. The sidewalk slab, 7-in. thick, was designed as simply supported in order to lessen the possibilities of cracking near or over supports; a single layer of triangle-mesh wire fabric was placed near the upper surface of the sidewalk slabs to prevent further any cracks from appearing.

Over the main abutments the roadway and sidewalks are carried by a house-like structure which rests on top of the solid concrete arch abutments. This house consists of four concrete walls with floors about 12 ft. apart. Windows, doors and stair wells are provided to make these floors useful. Access to the stair wells from the top of the bridge is by way of a circular balcony projecting from the outer wall. It is intended to build a comfort station on the top floor of the west abutment pier, while the other floors will later be utilized by the street and water departments of the city.

### Architectural Features

The appearance of the bridge was of primary importance, but, while the architectural treatment was designed to ornament the structure, in no manner did it interfere with economy or the demands of good engineering. It was early planned to abandon the conventional style of building longitudional face walls over the river piers to make such piers seem solid up to the roadway. Instead, a simple and uniform treatment of fascia girders and parapets in the 16-ft. spacing of transverse spandrel walls was adopted. The end faces of the transverse walls were treated in harmony. The top of each wall is crowned with a simple capital upon which rests the sidewalk bracket. Just behind the ornamental face of the walls is a battered buttress which adds to the appearance of the wall and emphasizes its stability. The battered buttresses curve into a band of concrete 18 in. thick and of varying height, resting upon the extrados of the arch. This band or fin has no structural significance and serves merely as an architectural device to tie in the bases of spandrel walls and give a feeling of greater stability.

Architecturally, the abutment towers are appropriately monolithic in appearance and flank the series of arches, separating in a most effective manner the long arch spans from the shorter horizontal spans of the approaches on either side. By cutting up the surface into small shallow square panels, the difficulty of of obtaining a high plane surface of uniform color and texture was obviated, and at the same time the monotony of plain surfaces was avoided.

### Construction Features

Simultaneous construction of the three large arch spans, use of wooden forms, and cableway transport of material from bank to bridge were the defining features of the execution of the work.

In May, 1918, the commissioners closed a contract with the John F. Casey Co., of Pittsburgh, to erect the bridge at cost plus a fixed compensation of $40.000, about 9 per cent. of the then estimated cost of construction. Work was not begun until the fall of that year, except in a preliminary way, as it was desired to utilize the lumber and plant then being used on the South Side bridge. Before completion of the latter the city purchased a twin cableway of 1,254 ft. span (138½-ft. steel towers), and this became the central item of the construction plant.

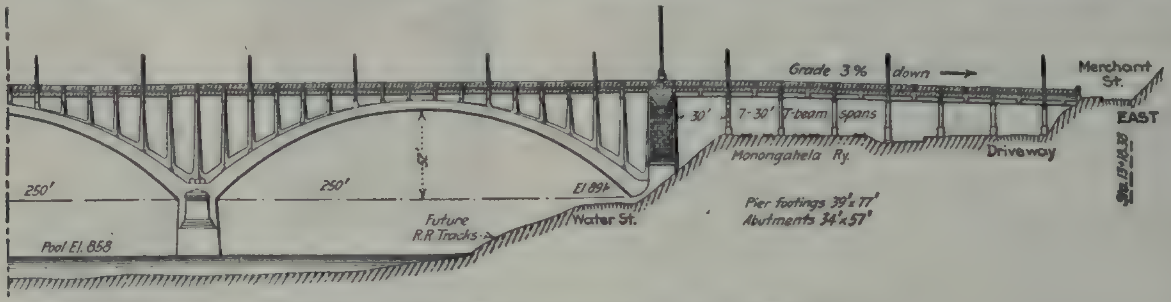
Showing architectural features of pier and walls.

In the winter of 1918-19, equipment having a capacity of 500 cu. yd. of concrete per 10-hr. day was installed. On account of lack of space on the west side, all operations of the contractor were concentrated on the east side. Several schemes for plant layout and units were considered and the economics of various arrangements of machinery and of renting as against purchase by the city, were studied. It was decided to rent the mixer and electric hoist and derrick which made up the machinery of the mixing plant. Saw mill and blacksmith shop equipment were bought by the city, as were also line hoppers, chutes, material derrick and all major and minor tools. Other rental units were derrick boat, centrifugal pumps, pile driver and steam hammer, concrete buckets, skips and excavation dump buckets.

### Arrangement of Plant

At right angles to the west abutment pier and about 150 ft. from the cableways, which were erected so that the cable distributed on the centerlines of the main arch ribs (28 ft. apart), was located a 2-yd. mixer, about 20ft. below the railroad tracks and set out far enough from the edge of the embankment to permit of a special siding serving the plant. Above the mixer was built a sand-and-gravel bin, with capacity of 200 tons of sand and 200 tons of gravel. Just to the south, storage bins of 3,000 tons capacity were built on the slope of the railroad embankment, with rough pile and board sides and floors. Dump holes under the track allowed all sand and gravel, which was delivered in bottom-dump coal cars, to flow into the bins. The mixer hoppers were served and kept full as needed from the storage piles by a 2-yd. clamshell bucket operated by derrick, which also assisted in unloading and piling sand and gravel. To the north, but directly built onto the mixer feeding platform, parallel to the siding, was constructed the cement shed, with a capacity for 4,000 barrels of cement. This arrangement allowed using cement from car to mixer in some instances, but on long runs there was not sufficient siding capacity, and so storage was necessary. Storage was a necessity also because of uncertain deliveries due to war conditions.

From the mixer mouth to the cableways was constructed a track on a level low enough to allow 3½-yd. buckets on a four-wheel flat car to be pulled in under the discharge hopper of the mixer. A 25-hp. electric hoist operated this car with an endless line back and forth from the mixer to cableway. This plant mixed and distributed into place over 600 cu. yd. of concrete in one continuous run.



|Profile of Bridge Structure Showing General Dimensions

The cableways, which were of 7-ton capacity, transported concrete chiefly, but also handled over 1,000 M ft. of lumber. They were operated with the aid of signal men and electric bells, as most of the time the operating enginemen, located on the east end, were unable to see where their loads were to be landed or picked.

After centering construction was started, an air compressor was installed on a rental basis, to supply air for three woodboring machines, which earned their cost over and over again in the drilling of holes for the thousands of bolts used in the centering. Further use of this unit was made in the rock excavating operations, drilling concrete, etc.

River pier construction was carried out in 1919. Cofferdams of steel sheetpiling driven to get a bite into the rock, bermed up outside with clay and boulders, and thoroughly braced were used at both piers. Abutments and approaches also were completed in that season. The arch ribs and most of the floor were constructed in 1920, running on into the spring of 1921, after which finishing, waterproofing and roadway work were done.

## Centering

The three spans were centered simultaneously and no center was struck until completion of the ribs of all spans. The centering of all spans differed, however, because of local conditions. That of the easterly span consisted of posts, braces, caps, joists and flooring, founded on river bottom on pile bents of six and nine piles, capped and braced. In the westerly span railroad tracks and freight sheds had to be spanned by structural steel posts and beams, on top of which timber centers carried the rib loads.

The middle span centering was designed to take care of a 60-ft. channel. There being no cover to the rock bottom under this span, and flood and drift risk being present, the posts of the centering were set on individual concrete piers, 2×4 ft., placed in the river by a cofferdam. Eight cofferdams were constructed, each holding six pedestal piers. For each rib the timber framework from the springing line up was arranged in umbrella shape and its loads were carried through hardwood caps and wedges down three 12×12-in. timbers to each concrete pier.

In all the centering, long timbers were used, which permitted longer spacing and less waste. All caps were 12×14 in.×60-ft. fir. These pieces were later used to material advantage in the erection of the superstructure.

## Concreting

One pair of ribs contains 1,800 cu. yd. The ribs of each span were poured in four operations, each requiring from 10 to 12 hr. Each rib was divided into seven sections. The crown sections of the two ribs of a span were poured first, the four skewback sections the following, and on the next two days the sections adjoining the crown and the closing sections respectively, completing the span. Work started in the easterly span and progressed in order to the west span.

Considerable effort was necessary to have sufficient material on hand for the completion of one pair of ribs, which meant four days running. The Baltimore & Ohio R. R. in several instances assigned twenty cars at a time to sand and gravel supply; Ohio River material was used coming from Wheeling. The Monongahela Ry. brought as many as ten carloads of cement in one shipment from the mill at Wampum, Penn.

The forms for the transverse walls were assembled of shop-built sections, heavily built for repeated use. Rapid progress was made on the walls, and as soon as they were well advanced work was begun on girders and brackets, following through with floor-slab and sidewalk construction.

The structure contains 24,880 cu. yd. of concrete 770 tons of reinforcing steel, and 220 M brick. Arches, floor, copings, parapet and superstructure details were made of 1:2:4 concrete; the transverse spandrel walks, approach bents, approach abutments and track, 1:2½:5; piers, abutments and approach foundations, 1:3:6. Its cost, exclusive of street grading at the entrances, was very close to $860,000.

The design was made by the Concrete-Steel Engineering Co., William Mueser, chief engineer, and Charles F. Bornefeld, resident engineer. Associated with the engineers was Major Henry Hornbostel of New York, as consulting architect. Samuel L. Fuller was superintendent on the work for the contractor. Shrewsbury B. Miller is city engineer of Fairmont.

# The St. Lawrence Waterway

## Recently a party of U. S. Engineers and Other Prominent men Viewed the river from Quebec City to Lake Ontario. Toronto and Montreal get Bouquets. Excursion Described

By C. W. BAKER
Director, The Engineering Business Exchange, New York City

An official excursion last month over the route of this waterway by a party of 150 prominent men from all parts of the United States was an event of outstanding international importance. The party included the Governors of nine states, four U. S. Senators and nine members of Congress. The other members of the party included bankers, merchants, shipping men, railway officers, publishers, college presidents, state officials and a considerable number of well-known engineers.

During the entire week the party were the guests, first of the Government of the Province of Ontario during a day's stay at Niagara Falls, and afterward of the Dominion Government, which placed the St. Lawrence passenger steamer Cape Eternity at the disposal of the visitors for the journey all the way from the head of Lake Ontario to Quebec.

Seldom if ever has so large a number of distinguished public officials and prominent business men been brought together to give an entire week to the personal inspection of a great engineering project.

While the social features of the excursion were notable, especially the hospitable receptions given to the visitors at Ontario, Montreal and Quebec, the outstanding feature of the voyage was the serious study given to the project at the daily meetings which were held on the journey. Epecially noteworthy was the announcement by the engineers of the project of the results of their surveys and investigations. The engineers' report was only completed on June 30.

For the benefit of those who do not have clearly in mind former published descriptions, it may be well to state here what the St. Lawrence waterway project is.

### The Proposed Developments

Briefly, it is proposed so to improve the St. Lawrence river between Lake Ontario and Montreal that ocean steamers can ascend the river and reach any port on the Great Lakes and that lake vessels can descend to the ocean. In improving the river for navigation, there will be developed a vast water power; and the sale of this power, it has been contended by friends of the project, can be made to yield profit enough to not only make the entire works pay for themselves, but yield a profit.

The benefits in reduced cost of transportation, especially to the Central West, are so enormous as almost to defy computation; but even more important than reduced cost is the ability to secure transportation when it is most needed and independent of car shortages. It is not generally known how seriously the farmers and business men of the Northwest have suffered during recent years of railway congestion through inability to secure transportation for their products.

Besides the St. Lawrence rapids, there is another barrier to be overcome to enable ocean vessels to reach the Upper Lakes. From Lake Erie to Lake Ontario there is a vertical falls 326 ft., which creates the great cataract of Niagara and the famous rapids above and below it. At present vessels pass between Lakes Erie and Ontario by the Welland Canal, which has locks of the same dimensions as the locks on the Canadian St. Lawrence canals. These are 200 ft. long, 40 ft. wide and 14 ft. deep.

### Inspected Welland Canal

In order to enable larger vessels to pass between these lakes, Canada began, in 1914, the building of a new Welland Canal with locks of 800 ft. length, 80 ft. width and 30 ft. depth. The official party gave Monday, July 11, to an inspection of the work on this canal.

These works are of vast proportions, quite comparable with those at Panama. The lock walls, in fact, are much higher, for the entire lift between the two lakes is made in only seven locks, requiring about 46-ft. lift in each lock. This is more than double the lift in the Panama locks; and the lock chambers are only 20 ft. narrower than those at Panama. The width of the Panama locks was determined by the beam of large battleships, not by the beam of commercial vessels.

Canada began this great work in 1914, expecting to complete it at an outlay of $50,000,000. Half that sum has already been spent, but the stoppage of the work by the war, with the great increase in price, has greatly increased the cost of the work. Notwithstanding present financial conditions, the Canadian Government is going steadily forward with the work.

The visitors were greatly impressed with the fact that this necessary part of the deep waterway route from the Lakes to the Atlantic is being carried forward by Canada entirely at her own cost, although she grants to United States vessels the same free use without the payment of tolls that her own vessels have.

This was an added argument to the visitors why the United States should be willing to assume its full share of the cost of the St. Lawrence improvement to give the same capacity for handling vessels that the new Welland will have.

### The Toronto Harbour

During the night on Monday the Cape Eternity crossed Lake Ontario to Toronto, and the entire day on Tuesday was spent examing the work of the Toronto Port Commission and the City of Toronto. The entire water front at Toronto is now in public ownership. The Port Commission has carried on great works of land reclamation and channel and slip deepening, with a view of accommodating ships of 30-ft. draft. In other words, Toronto is already building with a view of the future requirements of the deeper draft vessels which will use the St. Lawrence waterway.

Equally impressive were the substantial and well designed improvements which the city is making on the water front used for public recreation. The writer knows of no city in the United States which is dealing with its harbor, port and water front problem **with such sound engineering design, such careful foresight and such sound financial methods as Toronto.**

Incidentally, it is to be noted that Toronto is this fall to take over its entire street railway system, which will hereafter be owned and operated by the city.

An accident to the motive power of the Cape Eternity prolonged the journey from Toronto down the St. Lawrence to Montreal by 24 hours, but gave added time for thorough discussion of the problem by the party, both in formal meetings and by informal conversations.

During this journey the engineers of the International Commission, W. A. Bouden for the Canadian Government and Col. W. P. Wooten for the U. S. Government, gave summaries of their report.

Briefly stated, they propose to provide locks of the same vessel capacity as the new Welland Canal, and there will be only seven in the entire distance from Lake Ontario to Montreal. At the long Sault rapids the river will be improved for both navigation and power development by building a great dam and power house. This will drown the rapids and enable vessels to pass from the locks directly into deep water for open sailing instead of through a long canal, as is now necessary. The power house proposed will provide for 52 units, each of 35,000 h.p. capacity, or a total of about 1,800,000 h.p. This would be divided equally between Canada and the United States, and each nation could control its own half of the power house on its side of the international boundary and could do with the developed power what it chose.

As for the rapids below the international boundary, the plans contemplate improving the river here for navigation alone by the construction of canals and locks, leaving Canada to develop the water power on this section of the river, which is entirely within her own borders, as and when she pleases.

### A Quarter Billion

The total estimated cost of this entire development for both power and navigation is $252,000,000. If the entire cost of the improvement were charged to the water power development, the investment would amount to about $140 per hp. This would evidently be unfair, however. A fairer division would be to assume that one-third the entire cost is chargeable to power development, which would make the power development cost less than $47 per hp.

Bearing directly on this same subject was the statement presented by another prominent member of the party, W. S. Murray, who is in charge of the so-called "Super Power" investigation of the demand for electric current in the industrial zone extending from Boston to Baltimore. This report, which has just been completed and is not yet made public, will show that there is the most urgent demand for this power to supply needs already pressing, and that to attempt to generate the needed power by coal-burning stations means congestion of transportation lines and terminals that can but be disastrous.

Mr. Murray also stated that the transmission of this power for the 350 miles from the St. Lawrence to New York City could be accomplished at 220,000 volts pressure with a very high efficiency and very low cost, provided the power is transmitted in very large blocks, say 400,000 kw. on a single transmission line.

It is evident from Mr. Murray's statements, as well as that of prominent capitalists who were members of the party, that there is a market for the St. Lawrence power as soon as it can be developed, and further, that its supply is well nigh essential to the industrial prosperity of the great industrial zone of which New York City is the center and of New England.

The bearing of this upon the enterprise is evident. There has been opposition to the enterprise in New York and Boston because of the idea that the enterprise meant the building up of direct export and import business at the Lake cities. It is evident, however, that any detriment to the Atlantic seaport cities from this cause will be far more than offset by the gain from the power supply.

There is another feature of the St. Lawrence route that the trip served to impress on the minds of the visitors and that is the very short distance and time that now separates the Lakes and the Ocean.

Even by the present St. Lawrence canals the Cape Eternity was scheduled to make the trip from the foot of Lake Ontario to Montreal in a single day, between 6 a.m. and 11 p.m. The accident to her motive power with delays in the locks, due to the exceptional size of the steamer, made the journey much longer; but it was clear to everyone that with an improved river a vessel can certainly pass between Lake Ontario and the seaport of Montreal in a single day.

### Montreal a Great Port

Probably few Americans realize **what a great port Montreal has become and what splendid and economical facilities for handling commerce that port now offers.** Over $30,000,000 has been spent in the creation of the port's facilities and there is not a seaport in the United States that can show such splendid results in proportion to its expenditures. Today Montreal can handle traffic at a small fraction of the expense necessary to handle traffic in the port of New York; yet New York continues to invest her money in so-called harbor improvements which are planned, not with a view to economical operation, but to benefit local real estate interests.

The fact is that the Canadian Government authorities appear to have made far better use of engineering talent and shown greater wisdom in the selection than has been the case in the United States

Naturally Montreal has looked with some doubt upon the St. Lawrence project, feeling that her present position as the meeting place of lake and ocean transportation was one of great advantage. On the other hand, with the steady growth of traffic it is recognized that expansion of facilities will be necessary and Montreal will probably not oppose whatever will be of advantage for the Dominion as a whole.

Space forbids more lengthy discussion. Returning to the story of the trip, the features of the Montreal entertainment were a carriage drive in carriages drawn by horses to the summit of Mount Royal, which rises 750 ft. above the St. Lawrence. Two different hack drivers on this trip assured Colonel Wooton and the writer that the St. Lawrence itself at Montreal is 150 ft. above sea level! It may be here noted that the actual elevation is less than 20 ft.

# "Leadership" in Engineering

## The Importance of Educative Work and the Necessity for "Salesman" Qualities in Engineers, is emphasized in Valuable Article in the Highway Magazine

By C. HAGEMAN, C. E.

To a greater extent than is the case with almost any other professional man, the engineer is obliged to depend upon others than himself for the final results of his work.

No matter how clearly the ability of the engineer may be shown in his comprehension of the problem at hand, no matter how nearly perfect his plans, how complete his specifications, or how thorough his methods for getting the work done in the most efficient and economical manner, there finally comes a point where he must depend for results on the efficiency and spirit of good workmanship of the men on the job.

Where the work of the engineer is turned over for execution to an "outside" organization, as for example where construction planned is taken over by a contractor, the message of this article would hardly apply.

### Where Forces Converge

There are, however, many activities such as the engineering departments of railways, and to some extent the highway engineering departments of the states, where the engineer has at his disposal a permanent organization for the execution as well as for the planning of the work and where there is a constant contact and reaction between the engineering and the construction forces.

### The Engineer Must Lead

In such activities, as for example in the Maintenance of Way Departments of railways, the engineer is a good deal in the position of the general in command of an army. It is for him to plan and to organize for the work in hand. But just as the commander in the army is finally dependent for results upon the morale or spirit of workmanship of the troops and upon the abilities of his captains and non-commissioned officers to give leadership and to instruct, educate, and inspire, so the railway engineer is dependent upon his department heads and division engineers and particularly upon the spirit of workmanship of the foremen of the actual construction crews who may fairly be compared in importance with the "non-com" in the army.

Leadership is largely teaching—the ability to transmit to the other fellow just the education that is necessary to get the work done in the best way. In other words, to "sell" the other fellow the vision of the final result to be achieved.

Leadership is the ability to secure efficient cooperation, and that is generally impossible without full understanding and confidence.

In his work as engineer in charge of bridge, tunnel, and similar construction work for a western railway, the writer has had numerous occasions to observe the great values which result to the engineer if he can succeed in transmitting to his subordinates all the way down the line to the point where the work is finally done, an understanding of the reasons why certain things are done in a certain way and the relation of one man or one division's work to the work of other men or other divisions.

### A Case in Point

I had, a few years ago, a peculiarly interesting experience in this respect which it seems to me may be of some interest to engineering readers.

I had a discussion with my chief engineer relative to the possibilities of economies in the methods and materials used for the installation of culverts. The road was at that time using chiefly cast iron and concrete pipe for culvert installations, although there previously had been a number of installations for which corrugated iron pipe had been used. The chief engineer was inclined to the opinion that, from the standpoint of first cost at all events, there was a definite and substantial economy in the use of corrugated iron pipe, but he had no data showing the extent to which this would stand up in service, and could not, from the data at hand, draw a conclusion as to their permanent value.

The chief, therefore, instructed me to make a complete investigation and report on this subject. I accordingly made a complete trip of inspection over our line from the coast to the foot hills of the Rockies, personally inspecting the condition of culverts of all types and gathering data as to their then condition, the length of time they had been in service, and similar information. I also discussed the subject with section foremen, bridge foremen, field engineers and with engineers of other local railways within this territory as ameans of checking and making a comparison with the results of my own research.

Of the total number of corrugated iron pipe culverts, I made a close inspection of about twenty-four, going to the extent in some cases of having these pipes uncovered so that the inspection could be made of the outside as well as of the interior of the pipe.

Of these twenty-four culverts, I found that the majority had been in service for a period of about ten years some of them a little longer than that.

These were of various sizes, installed under various conditions of climate and soil, under both shallow and deep fills, my object being to obtain a record of performances under as many different kinds of conditions and installations as possible.

### The Result of Inspection

In every case the corrugated iron pipe inspected was in excellent condition and giving efficient and satisfactory service. In no case was there any serious distortion of the pipe due to the load carried, even under the extremely heavy fills. Some of the pipes had been distorted longitudinally due to uneven subsidence of the ground supporting the fill, but this distortion was not sufficient in any case to interfere with the effective service of the pipe.

A most thorough inspection was made with reference to the effect of rust, and in this respect to my surprise the culverts were all in excellent condition with the exception of one pipe which was found to have been pitted through in several places. This pipe was analyzed, however, and found to be steel and not iron.

After collating the data from this investigation, I was naturally tremendously impressed with the uniformly good record of service which had been shown by corrugated iron pipe and surprised by the fact that, in view of this uniformly good showing, a preponderance of this material had not been used for culvert installation.

### Putting the Pipe "in Wrong"

It was right here that I put my finger on the difficulty and got my demonstration of the tremendous importance of the "human factor" in work of this or a similar kind.

During the investigation I had constantly come in contact with many off-hand general comments from section foremen and bridge foremen to the general effect that corrugated iron pipe for culvert was "no good." In some cases where I had pinned these men down to definite statements, I found that they were unable to give any definite reasons for such a statement, especially in the face of excellent service by such material as shown by my inspection in their own sections.

My final analysis of the situation was this: It is common practice on railroad maintenance work for bridge crews to install culverts. This is so because these crews are equipped to handle heavy loads such as large cast iron or cement pipe and they also understand how to bridge the opening under the track while the pipe is being placed.

With the advent of the corrugated iron culvert pipe, the division engineer hit on the bright idea of letting the section crews install these, as no heavy tackle would be required, and because of the comparatively light weight of the pipe, it would not be necessary to bridge the opening but merely to dig a ditch under the track, throw the pipe in and back-fill in a hurry, all between two trains; and that is just what happened.

The section foreman, with all his manifold and important duties, would not welcome this addition to his troubles and as a natural consequence would take it out on the pipe saying: "It's no good anyhow."

The bridge men who do not like encroachments in their field of activity any more than you or I do, would also take their wrath out on the corrugated pipe. "That kind of junk is no good," they would say. From the section foremen and bridge foremen, this sort of unfounded comment was passed on until everybody had it.

The consequence was that in spite of the fact that the corrugated culvert had been entirely satisfactory everybody admitted when driven to it—there had been ten years during which very few, if any, had been used, when as a matter of fact the use of the corrugated iron culvert pipe for the smaller drainage ways would have been eminently cheaper and frequently more satisfactory in service, especially had it been installed with half the care given to cast iron and concrete pipes.

### The Real Selling Job

Now let us assume that when corrugated iron pipes were first installed that the division engineer ordering them installed had, either personally or through one of his subordinates, or by means of a careful circular to both bridge foreman and the section foreman in that division, given them an adequate conception of why these pipes were being ordered installed, of the economies that they could effect for the company if they proved serviceable, as they did; that the installation of these on account of the lack of necessity for heavy tackle and hoisting machinery would relieve the bridge crew of a considerable part of this work, and that, while this work would then fall upon the section crews, the pipe is so comparatively light and its installation so comparatively simple and easy that it could be easily handled by the section gangs, and that the net result would be a definite gain in economies of operation in the maintenance of way for the company.

I have no definite suggestions to offer as to how the engineer at the head of such engineerng organizations and departments can systemize educational work of this kind so that he can sell his "non-coms" or if necessary his "dough boys" in matters of this sort. I am merely offering my experience in this particular case and the general suggestions in this article as something of possible service.

I feel very definitely certain that the engineering profession has a selling job on its hands, and that job runs into two channels. First, the general public should be sold on the tremendous economic value to the nation of the service of trained and competent engineers—must be sold on the enormous value which is added by engineering science to almost every department of our national life, social, industrial and agricultural. Second, some means for educating the "armies" through which engineering science is made effective; some means of developing the morale and spirit and securing the genuine co-operation of the worker.

In an address delivered a little over a year ago, the chief executive of a great engineering organization said that one of the greatest needs in the engineering world now is to develop the quality of leadership among engineers and bring home to them the fact that the engineer's greates problem is the problem that confronts creative executives in every field and that is to develop and intensify the efficiency of the human material with which the engineer works and without which he is helpless, and that to secure the earnest co-operation of the "human factor" the engineer must give leadership, and leadership is largely the ability to teach and inspire.

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### Venturi Meter Contract.

An important Venturi meter contract has just been awarded in the city of Montreal to the General Supply Company of Canada, Limited, Canadian representatives of the Builders Iron Foundry, Providence, R. I. The contract covers a number of 36" venturi meter tubes and type "M" register-indicator-recorders for Montreal's $9,000,000.00 pumping station now under construction at the foot of Atwater Avenue. This station when completed will be one of the largest and most modern on the continent.

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### Electric Travelling Cranes

The Northern Crane Works, Limited, of Walkerville, Ont., have issued an interesting bulletin, describing their type "E" electric travelling crane. This bulletin No. 504-C is well illustrated, showing the various parts of the crane and its operation under varying conditions.

# Don't Base Your Tenders on Guesses and Averages. Know the Facts

"Steel Structures," a publication by the Structural Steel Section of the British Engineers' Association, contains, in a recent issue, some valuable suggestions in the way of a list of requirements—reminders, they might almost be called—all of which must be taken into consideration before a contractor is in a position to submit an intelligent tender. A list is submitted for steel bridges and also for steel-frame buildings, the latter of which we reproduce below as being almost equally applicable to local conditions.

If there is one fault greater than another that can be placed at the door of the contractor preparing his tender, it is that he does too much guessing—he averages too much and, all too often, forgets too much. A reminder list, showing all the essentials, has frequently been proven of the greatest value in avoiding errors. The list with regard to steel-frame buildings is as follows:

### Foundations

Are these composed of concrete or stone? If the latter, what kind? If designers' advice on foundations desired, state nature of the ground.

### Arrangement of Building

Give a sketch showing length and width of building, and another sketch showing height to eaves.

State whether the roof is to be flat, ridged, or curved.

How many floors are required? Indicate the number, and state the various heights, saying whether from floor level to floor level, or from floor level to the underside of floor above.

If more than one bay in width required, give width of each bay and state number of bays.

Can the number and positions of stanchions be left to the discretion of the designer?

If special circumstances rule positions of internal stanchions, the positions of these stanchions should be indicated on a plan.

Note that extreme minimum number of stanchions increases the cost of the structure.

### Floors

Are the floors to be constructed of: Steel beams with timber joists and boarding; or steel beams with concrete filling; or steel beams supporting reinforced concrete slabs?

What is the approximate dead weight of floor per super foot (or other square measure) exclusive of steelwork?

What is the load per super foot which the floor is to support exclusive of its own dead weight?

Is machinery to be supported?

If so, what is the equivalent load of this machinery per super foot? Or give weights, and, if possible, the positions of the various machines.

Indicate any openings required in the floors.

Indicate any concreted loads on the floors or on the roofs.

### Walls

What materials are the walls to be built of?

Are these walls self-supporting, or curtain walls carried on wall beams?

If the walls are to be sheeted, state whether the corrugated sheets are to be galvanized or black painted, and whether any particular guage is desired, and, if the building is an important one, specify the amount and size of end laps.

For sheeted walls, state whether the supporting rails are to be of steel angle or timber.

### Roof

Give sketch.

State whether flat, ridged, or curved type.

State whether tie bar is to be horizontal, raised, or curved.

What roof covering is required, corrugated iron, slates or tiles?

Are these to be included for?

Is any particular gauge of corrugated iron required?

State amount of end and side laps.

Are the purlins to be of steel or timber?

If the roof covering is of tiles or slates, are they to be supported on boards, spars and battens, or steel angle laths.

Is any shafting to be supported by the roof?

If so what diameter of shafting?

What are the particulars of loads and their positions? And give maximum size of belt.

### Glazing

What amount of glazing in the sides, ends, and roofs?

Is it to be of timber or steel construction?

### Ventilation

Is this to be provided by natural methods, that is—open and fixed louvred ventilators, or mechanical, revolving, or other similar ventilators?

### Doors

Indicate position and size of doors.

State whether timber framed or steel framed, and panelled with timber, or corrugated iron sheets.

State whether sliding or hinged type, and whether single or double doors.

### Windows

State number, position and size.

Whether timber or steel framed.

Whether external or internal glazing.

Whether of fixed type or hinged type, and give number of panes to open, and indicate type of opening gear required.

State whether separate shutters are required.

### Glass

State thickness for windows.

State thickness for glazing.

Whether plain or wired glass is desired.

### Staircases

State whether these are to be built of steel.

Give number, position, size and type.

### Crane Runways

Where crane runway is desired, state:—centres of the supporting stanchions; the load capacity of the crane; the span of the crane; if possible, the wheel base of the crane.

How many cranes will be operating in the same runway?

End and overhead clearances.

Is the crane electric or hand propelled?

### Gutters and Pipes

State whether these are: -Cast iron, galvanized iron, or steel painted type.

If any particular positions desired for downpipes, they should be indicated.

### General

For what purpose is the structure required?

What portions of the structure will be assembled by means of bolts at the site, and by means of rivets at the site?

Is the steel to be painted or oiled before delivery? How many coats?

Is any paint to be forwarded for use at the site?

Are any units of the structure required to be sent unholed to take advantage of a differential customs tariff?

If the structure is a large one and it be not advisable to dispatch in one shipment, state order of delivery required.

If the job is urgent, state whether the foundation bolts and any other steelwork for the foundations should be dispatched from stock as a separate and advance shipment.

State whether price required: f.o.b. British port, c.i.f. the port of destination, erected complete, if supervising foreman only required.

Should it be desirable that the building be designed to conform with local bylaws forward a copy of such with enquiry.

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## A Water Supply for the Eastern Division of the Township of York

The residents of the section of the Township of York lying between Don River on the west and Scarborough Township on the east have been agitating for a municipal supply of water for several years. The city authorities stated that they could not give a supply, with the result that the Township Council gave instructions for investigations to be made as to the possibility of obtaining a supply of water from the east Don River and from the lake at Scarborough Beach. The engineers prepared reports on these possible sources and the matter was carefully considered by the council. Having regard, however, to the proximity of the city, the fact that the majority of the residents work in the city and spend the bulk of their money in the city, and to the possibility of future annexation by the city, it was deemed wise by the council to again approach the city authorities. After much negotiations the Township was granted a supply limited in the first period to 25,000 gallons per day. When this assent was obtained from the city council, instructions were issued by the township council for the work to proceed and it was carried out sufficiently to permit water to be turned on to the Eastern Section on Saturday, September the 24th at the Sammon Avenue pumping station at 4 o'clock in the afternoon by Reeve F. H. Miller.

The water is received in bulk from the city at twenty cents per 1,000 gallons and distributed by the township at 30 cents; the difference is to cover the losses and cost of administration.

About 5½ miles of 12" pipes and about 8 miles of 6" pipes have been laid in the Eastern Section at a cost of about $300,000.00.

An elevated steel tank capable of holding 200,000 imperial gallons and standing at about 150 feet above street level has been constructed by the Canadian Des Moines Steel Company of Chatham at a cost of $30,000,000.

Two pumps were supplied by the Canadian Allis-Chalmers Ltd. each having a capacity of 240 gallons per minute working against head contained in the elevated tank.

The pumphouse and workshops were erected by T. F. Norman of Blandford Avenue at a cost of about $8,500.

The electric light and power connections were installed in the pumphouse and workshops by Ash & Hicks of Todmorden at a cost of $700. The Toronto Hydro-electric Commission have constructed a power line to the pumping station.

The Eastern water area measures about 1200 to 1400 acres and the population is estimated at about 12,000.

The following are some of the contractors: Cast Iron Pipes, National Iron Corpn. ft. Cherry Street, Toronto. Special Castings and Hydrants, J. T. Hepburn, 18 Van Horne Street Toronto. Gate Valves, Drummond McCall, 373 Front Street, E. Toronto. Meters, The Neptune Meter Co. 1195 King Street, W. Toronto.

The urban portions of York Township now have a large system of watermains as the districts of Swansea, Runnymede, Mount Dennis, Silverthorne, Fairbank, Oakwood, Wychwood, Earlscourt, Cedarvale, Spadina and now Todmorden, Greenwood and Eastdale have about 88¾ miles of pipe lines constructed at a cost of about $2,000,000.00. The water consumption in the western section during the last June quarter was about 51,000,000 gallons which was equal to about 22 gallons per head daily, an exceedingly low consumption compared with that in the city and elsewhere.

The Engineers are Barber, Wynne-Roberts & Seymour, 40 Jarvis Street, Toronto. The whole work was carried out under the inspection of the city officials.

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## Wages Too High in Barton Township

The township of Barton, Ont., will not be able to collect from the Ontario government 40 per cent. of the cost of roadwork done on township roads last spring and during the early summer, as the wages paid for foremen, teams and laborers were higher than those recognized by the provincial public works department. The council sent a bill to the department for over $4,000 some time ago and when enquiries were made of the minister of public works as to why it had not been paid, it was stated that the account was not in accordance with the statutes and that a revised bill should be sent in.

The department, it appears, will pay 40 per cent of the work on this wage scale: Laborers, 40 cents an hour; foreman 50 cents; teams. 80 cents. Prior to a month ago when a cut in wages was made by Barton council, the scale paid was as follows: Laborers, 55 cents; foremen, 60 cents, and teams, 80 cents.

# Lime Plaster on Metal Lath

## Some Valuable Working Hints For the Contractor

By NORMAN G. HOUGH
Director of the Construction Bureau, Lime Association.

Metal lath is being steadily accepted by the architectural profession and building public as the logical interior lathing material, due to its ability to enhance the protective value of plaster under fire conditions, the ease and economy of application, and its generally fundamentally sound final results.

Let us consider for a moment, the functions of interior plastering. It serves three purposes; first, it is purely a decorative material, or what possibly would be more nearly correct, a base for decorations. Second it serves as a sound deadener, by reducing to a minimum the passage of sound from one room to another. Third, it protects the structural frame of the building against fire.

Let it be said here that the interior plastering of any building, and especially residences, is one of the most important parts of the construction, and the selection of materials to be used and the workmanship in application should be given the same keen consideration as is given to the selection of a rug to be laid on the living room floor. Any defect in the plastering is certain to be seen almost as often as one enters the room.

Truly indeed one is unfortunate who is compelled by force of circumstances to pass through the ordeal of repairing plastering. For this reason the subject of interior plastering justifiably stands out as the most important part of the interior of a building, and a part which is worthy of weighty consideration, especially on the part of a prospective owner.

### Plastering Receives too Little Consideration

In spite of the importance attached to the finished walls, the subject of plaster and plastering is the one phase of building construction to which people give little consideration.

For this reason the art of plastering has been retrograding for years past rather than keeping pace with other materials of construction in the efforts to improve and perfect materials.

There is good reason for this, too. The general prospective home owner has not been taught to know what the pitfalls in interior plastering are and how to guard against them. When a broad educational campaign has been conducted, it is quite certain to restore the art of plastering to its truly important place among the various crafts in building construction, and what is more, it will protect the investment of thousands of prospective owners. It is to be hoped this condition will soon be realized.

Let it be said that in burning limestone, the raw product from which lime is made, it is necessary to hold the temperature at from 1500 to 1700 degrees F. for a considerable period of time, to destroy the union between the calcium exide and carbon dioxide. Lime plaster in itself is an incombustible material and this material applied to metal lath, another incombustible material, forms a combination which will withstand an intense heat for any reasonable length of time and still be a fire retarder. Metal lath offers the best possible key and acts as a reinforcing element within the plaster to prevent cracking under the severe temperatures caused by fire. The metal lath does not expand to break the plaster key, so that the combination of lime plaster on metal lath will stand intact, and function under the most severe conditions, maintaining its excellent heat insulating value to prevent flames spreading to attack structural members of the building.

The ability of lime plaster to deaden sound in such buildings wherein perfect acoustics or quiet conditions are essential or desirable, is another feature why many architects specify this material. A number of types of buildings come under this heading; among them can be mentioned churches, schools, hospitals, hotels, residences, etc.

### True Surfaces

In days gone by it was customary to rod all planes with a long straightedge in order to insure true and even surfaces. There was a time when it was quite common to see the architect and plastering contractor passing from room to room with a long straightedge, the contractor furnishing visual evidence that the walls had the prescribed thickness of plaster.

This practice, however, ceased in many classes of structures and today it is quite common to see base boards, picture rails, door jambs, etc., within an eighth or quarter of an inch of having a snug fit against the plaster.

Lime plaster, being a slow setting material, permits the mechanics to "straighten up" the walls and angles, thus eliminating without expense the excellent harboring places for vermin that is so often found between the wood trim and plaster.

### Three Vital Factors

There are three factors of vital importance in securing good plastering, and it is lack of proper attention to these fundamentals that contributes largely to plaster failures. First, the plaster must have adequate "key;" Second, it must have "body;" Third, it must not be "oversanded."

Metal lath provides against abuse the two first mentioned fundamentals, because plaster cannot be applied without pushing it through all the meshes of the lath, thus forming a strong key, and in plastering on metal, it is necessary to apply three coats, which provide the necessary body. The last mentioned fundamental can be corrected only through adequate inspection or through the use of prepared plaster (lime and sand properly mixed at a mixing plant and delivered, ready for application after mixing with water) or through the consideration of bids from reliable contractors only and placing the contract in the hands of one who is known to do first-class work. Good plastering costs only slightly more than poor plastering, and there is no part of the construction where high class workmanship gives such permanent satisfaction.

When these fundamentals have been corrected, and not until then, the first step will have been taken toward a return to the good old fashioned plastering that was generally found in days gone by.

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Robert Stewart, Limited, Guelph, Ont., recently commenced work on a new planing mill and sash and door factory to replace the one recently destroyed by fire. The new factory will be two storeys, 110 feet by 152 feet, and of solid brick construction. In addition to the factory, they are erecting a dry kiln, office and large warehouse.

# Trucks Prove Their Worth on County Road Building

By WILLIAM TONKEL

In Municipal and County Engineering.

(Editor's Note:—The following article is based on the experience of Allen County, Ind., in the operation of a fleet of 3½-ton Acme trucks on county road work. This county has saved $28.80 per day by using trucks.)

Our original Acme truck is approximately 3 years old, and the other two are nearly as old. All three 3½-tonners. Besides our Acmes we are working 4 trucks of other makes ranging from ¾ to 3½ tons. In a recent gasoline consuming test the Acmes got 80 miles on 17 gals., while other 3½-tonners needed 21½ gals.

The thing that first made me believe that the Acme was the truck for our work happened some four years ago. There were 8 trucks of several different makes building a road at the end of a 7-mile haul, and each truck was handling 3 yds. of gravel to a load. The road was slightly hilly, and in some parts not very good. The Acme was the only truck that could take its load over certain places without shifting gears, and the one truck that performed its work in good shape. This performance, I have since learned, is not unusual with Acme trucks.

Allen County uses its trucks entirely for maintenance and repair work. When new roads are to be constructed, the work is let out under contract. For this maintenance and repair work we decided that a 3½-ton truck would be best, for a 5-ton truck is too heavy. Our trucks have a 3½-yd. body, which is always heaped up, so we carry approximately 4 yds. of stone, weighing approximately 5 tons. This is something of an overload, but our trucks stand up very well under it The northern part of Allen County is rather hilly; the rest is fairly flat. Our roads are made of crushed stone, macadam and gravel.

At present we are repairing a piece of road 10 miles from Ft. Wayne, making a 20-mile round trip. The material is crushed stone, which is delivered at Ft. Wayne in freight cars. The truck is loaded by hand or by a chute, and run out to the point where the road is being repaired. The driver opens the rear gate 3 or 4 ins., by loosening a chain. Then he gets into his cab, raises the dump body and starts the truck, so that a stream of crushed stone flows out of the rear end of the body and is distributed evenly along the road. After discharging his load he returns to town for another.

It is very easy to make 4 such trips in a day, and if forced a little we could make 5. However, making 4 a day, we could can haul 16 yds. of stone per truck to the point. The cost per day on this haul is $19.26, or $1.20 per yard and $1.24 cts. per yard mile. If a team were to do this work it could make only one trip a day hauling 2 yds. of material. A team costs $6 a day, so it would cost us $3 per yard to haul stone to this point, against a cost of $1.20 by truck. Besides, a team could not spread the stone as the truck does.

Suppose that, instead of repairing this road, we were building it. It takes 1,166 yds. of gravel to build a mile of road. Hauling by team and handling 2 yds. of gravel per day, it would take us 583 days to perform the work. A truck handling 4 yds. of gravel to the load, or 16 yds. a day, could do it in 67 days. At the very low cost of $6 a day for a team, it would cost us $2,208 to haul the material; hauling by truck, at a cost of $19.26 a day, it would cost us $1,290.37, giving us a saving of $917.63.

Building a mile of road that distance from town would cost us by truck $1.11 per yard, and by team $1.89 per yard, a saving of 78.7 cts. per yard, or 41.6% in favor of the truck. But even though the truck did cost more, it would still pay a road superintendent to use a truck because of the greater amount of material that he could handle in a given time. As in all outside work, it is necessary to make the most of good weather.

The trucks employed in this service make a very high mileage, averaging from 75 to 90 miles a day. The average for an Acme truck last year was approximately 74,5 miles. The very low fixed expense of 93.3 cts. a day is due to the fact that these trucks have no taxes, license or administrative overhead, and only a low garage and insurance charge. Last winter was very open and we were able to work 285 out of 305 working days. The average cost for the time worked was $18.37 per day. All our repair charges are lumped, but the $600 per year allowed is ample.

COST DATA ON OPERATION OF 3½-TON ACME TRUCK, AS OPERATED BY ROAD SUPERINTENDENT, ALLEN COUNTY, FT. WAYNE, IND.

| | |
|---|---|
| **AVERAGE COST** | |
| Cost per day (including driver) | $ 18.3671 |
| Cost per mile | .2465 |
| Total cost for period (one year) | $5,235.28 |
| **OPERATION** | |
| Days operated | 285. |
| Miles traveled | 21,235 |
| Miles per day | 74.5 |
| Miles per gallon of gas | 4.7 |
| Miles per gallon of oil | 160. |
| **ITEMIZED COST** | |
| Driver cost per day (included above) | $ 5.35 |
| Depreciation per mile | $ .0428 |
| Maintenance & repair, estimated, per mile | $ .0283 |
| Tire cost, actual, per mile | $ .0335 |

Our trucks are run at an average speed of 14 to 15 miles per hour, and the Acmes are the only trucks we have that can travel 18 miles an hour without injuring themselves.

A summary of the cost data is given herewith.

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# The Value of Standardized Construction Equipment

By H. A. HOOKER

Austin Machinery Corporation, Chicago, Ill.

For years the value of standardizing on machinery has been recognized by manufacturers of many classes. Contractors on the other hand, have been very slow to see the advantage.

A contractor depends much upon his superintendent when the purchase of a machine is taken up. Often the contractor overrules the superintendent, whose inclination is naturally toward standardization when possible. Contractors seldom admit losses and therefore a contractor often thinks his competitors are more successful than himself, and must have better machinery, especially if he remembers how the purchase was influenced by price.

Today, however, some of the large contractors are becoming alive to the value of standardization of equipment. They have their engineering department keep cost records and make comparisons of operating costs versus depreciation and upkeep. These records are not simple to keep as to be accurate and useful they must take into consideration many conditions of material, labor and climatic interruptions. The same crew and equipment may lay ten or a thousand lineal feet of concrete pavement, depending upon one or all of a half dozen contingencies.

The money that a contractor makes is the difference between his costs and his contract price. His contract price should be based upon the average cost plus depreciation of equipment, and profit, and, naturally, the more accurate his costs the more certain his profits. At this very point, standardization means much to him in real money, as it gives him a more accurate average cost, and this in turn makes his chances of obtaining a profitable contract that much better. His foreman are interchangeable, as well as the parts of his machines; his operators, assistants from waterboy up become schooled so that the loss of an operator is not a calamity, and the men do not feel so independent and therefore more liable to make an extra effort to please. Every contractor tries to keep some repair parts on hand and standardization simplifies the ordering of the same.

The greatest effort at standardization that has come to my attention was that of Bates & Rogers of Chicago For one and one-half years they tested and kept cost records on six different makes of paving machines after which they standardized on one make, contracting for eight pavers and selling the others.

Standardization of equipment allows little chance for the passing of responsibility, as one superintendent has an equal chance with another and it creates a contest of superintendents in appearance of machines, upkeep expense and work produced. This spells profit for the contractor.

When possible to purchase full equipment from one company, and time payment is desired, financing is much simplified.

## Toronto Asphalt Roofing Manufacturing Co.

A new Canadian roofing company has recently been formed, under the name of Toronto Asphalt Roofing Manufacturing Co., Ltd., and has erected a factory with a single-unit plant at Mount Dennis Ont., a suburb of Toronto, at a cost of approximately $70,000. This plant has a floor area of about 250 ft. by 60 ft.

J. W. Milne formerly superintendent of the Brantford Roofing Co., is president; J.J. Kelly, at one time industrial commissioner of Brantford, is vice-president; J. Dugdale, formerly a salesman for the Brantford Roofing Co., is treasurer; F. P. Turner, hardware merchant of Port Colborne, Ont., is secretary, and W. S. Milne, superintendent of the Massey-Harris Company is a director.

The new company is now manufacturing asphalt roofing of the best quality and intends to branch out into other lines as opportunity offers.

The head office of the company is situated at Mount Dennis, Ont.

After an illness of several months John M. Gill, for many years associated with the James Smart Manufacturing Company as its president and general manager, and one of the most prominent residents of Brockville, is dead.

## No Improvement in Employment Situation

The Department of Labor, Ottawa, reports the volume of unemployment, as sent in from employers for the two weeks' period ending August 27, as practically the same as that registered a fortnight previously, the index number of employment standing at 88.7, as compared with 89 on August 13. This is taking as the base number, 100, the employment conditions during the week of January 17, 1920.

The employment situation is much less favorable than during the corresponding period of last year. This is indicated by the following table of index numbers of employment for the various districts into which the country is divided for the purposes of this review:

| | Aug. 13, 1921 | Aug. 27, 1921 | Aug. 28, 1920 |
|---|---|---|---|
| Maritime Provinces ... | 91.9 | 93.5 | 111.3 |
| Quebec and Ontario ... | 86.0 | 85.3 | 106.6 |
| Prairie Provinces ..... | 98.4 | 98.5 | 108.5 |
| British Columbia ...... | 96.6 | 95.6 | 109.3 |
| CANADA . . . . . .... | 89.0 | 88.7 | 107.5 |

## Useful Data

A cubic foot of lump lime weighs from 60 to 70 pounds.

A 200-pound barrel of lime contains 180 pounds net of lump lime, or 3.1 lubic feet.

A 300-pound barrel of lime contains 280 pounds net of lump lime, or 4.7 cubic feet.

A bushel of lime contains 60 to 80 pounds, or 1 to 1.3 cubic feet, depending on the state laws.

A pound of magnesium lime requires about one pound of water to form a paste, or about 25 gallons a barrel.

A barrel of lump lime gives from 6 to 9 cubic feet of paste; average about 7½ cubic feet.

A cubic foot of hydrated lime weighs from 30 to 45 pounds, average about 38 pounds.

A small sack of hydrated lime contains 40 pounds, or 1 cubic foot.

A standard sack of hydrated lime contains 50 pounds, or 1¼ cubic feet.

A large sack of hydrated lime contains 100 pounds, or 2½ cubic feet.

Hydrated lime requires about an equal weight of water to produce a paste. A 100-pound sack of hydrate gives about 2.3 cubic feet of paste.

A standard barrel of Portland cement weighs 376 pounds net and contains 3.8 cubic feet.

A sack of Portland cement weighs 94 pounds and contains about one cubic foot. It is usually considered as 100 pounds.

Cement paste weighs about 137 pounds per cubic foot.

One cubic foot of Portland cement will yield 8 cubic feet of paste.

The average wooden wheelbarrow load of broken stone is about 2.4 cubic feet.

The average wheelbarrow load of sand is about 2½ cubic feet.

## A Review of Commodity Prices

An interesting chart, which we reproduce, has been prepared by Dwight P. Robinson Company, engineers and constructors, of New York, covering the price tendencies in nine grades of commodities, from July of 1914 to July of 1921. The curves are somewhat complicated, but in the main indicate very clearly that since the latter part of 1919 and the early months of 1920, recessions have taken place more rapidly than advances were shown during the days immediately following the war. For example, farm products—which, by the way, never soared as did many of the other products—are back almost at pre-war prices, some 12 to 15 per. cent above 1914. Food, according to this chart, is 30 per cent. above 1914 prices. Clothing is still 80 per cent. higher; fuel and light, 90 per cent.; lumber and building materials, 100 per cent.; house furnishing goods, 150 per cent.

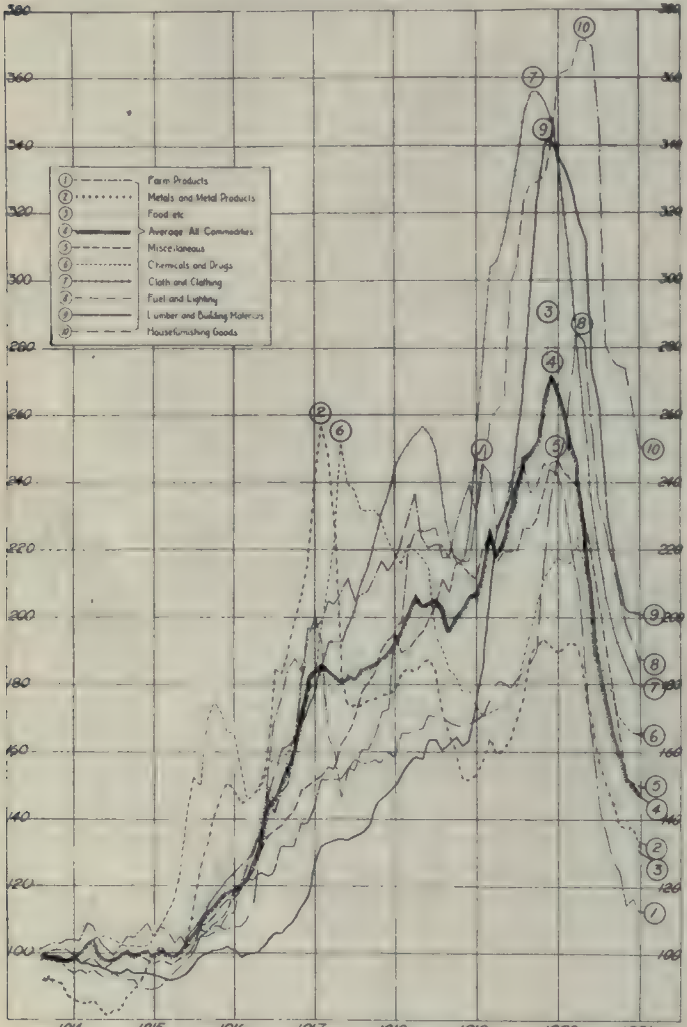


Chart Covering Price Variations

According to this chart, increases from 1914, in percentages, were as follows: Farm products, 146 per cent.; metals and metal products, 167 per cent.; food, 187 per cent.; chemicals and drugs, 152 per cent.; cloth and clothing, 256 per cent.; fuel and light, 184 per cent.; lumber and building materials, 241 per cent.; house furnishing goods, 271 per cent. The reductions from peaks in pecentages work out as follows: Farm products, 91.1 per cent.; metals and metal products, 79.6 per cent.; food, 82.9 per cent.; chemicals and drugs, 56.6 per cent.; cloth and clothing, 68.7 per cent.; fuel and lighting, 52.7 per cent.; lumber and building materials, 57.7 per cent.; house furnishing goods 44.7 per cent.

The average increase over 1914 works out to 172 per cent and the average reduction from peak is 72.1 per cent.

## Building a "Modern" Home

It is one thing to build the framework of a house, but quite another thing to finish it in such a way that it becomes a home. The modern home means an organization where the efficiencies are as great as they are in the factory or office. No business man would tolerate poor lighting in his factory. He has all the latest labor saving devices. Everything is installed that tends to reduce the cost of his product and increase its value to the public.

We have been slow in recognizing that the home ought to be operated in much the same way. We have been content to use the methods of 50 years ago, knowing well, if we have ever given it a moment's thought, that there are modern ways of doing the same thing more efficiently, less expensively and in such a way as to conserve the energy and patience of the house-wife.

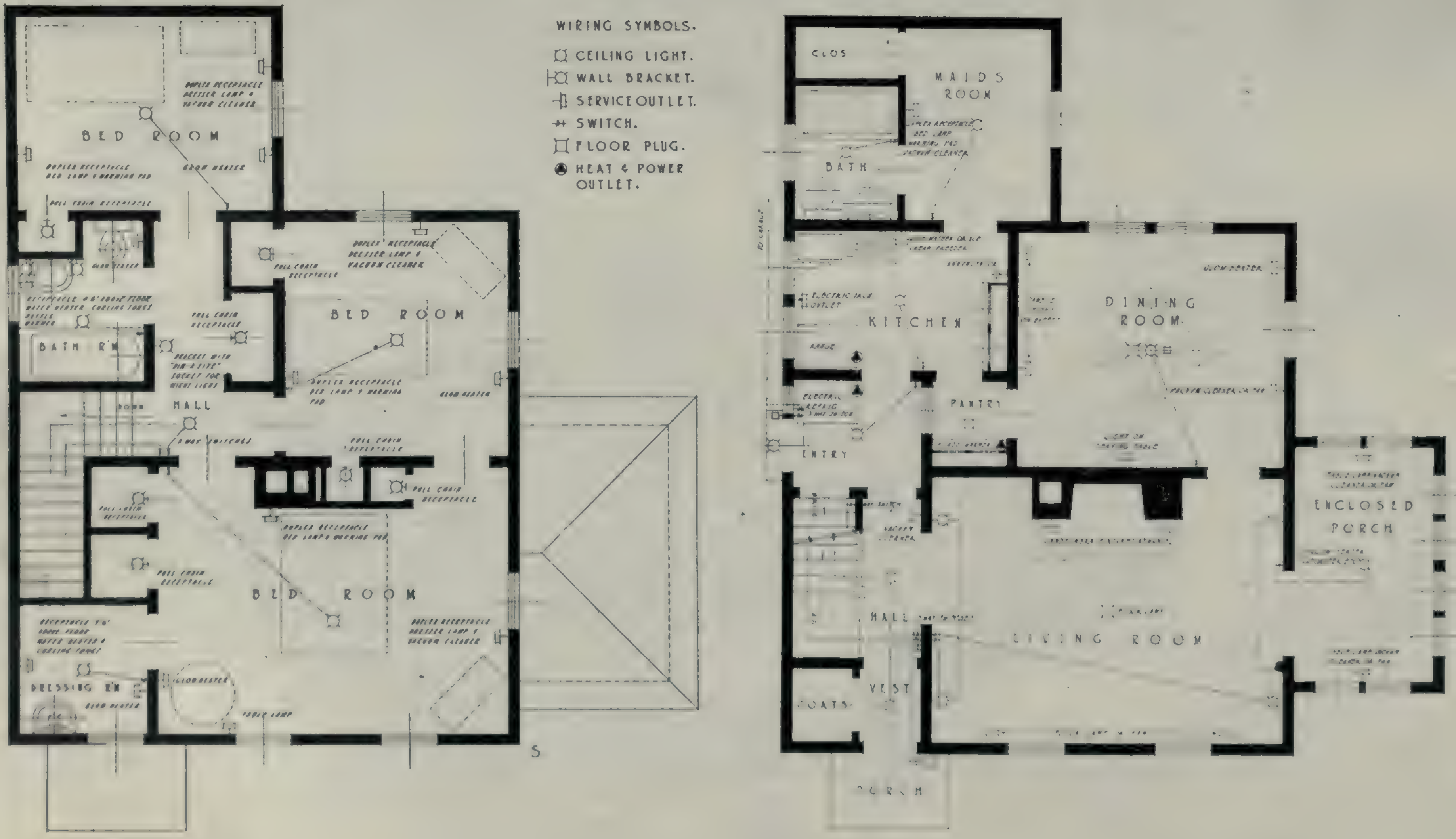
Strange as it may appear, there are many factories thoroughly equipped electrically, but few homes. It may be that contractor and architect have not given as much attention to this matter as its importance justifies. It may be that they have looked upon it more or less as a technical subject and, lacking the necessary knowledge, have fought shy of it. It will, in any case, be of interest to our readers to study the interesting model home plan shown on the following page. This wiring plan was prepared by the executive of the Ontario Association of Electrical Contractors and Dealers, for display at the Canadian National Exposition. A study of this plan will show that comfort and convenience are the considerations in this layout and that practically every contingency has been taken care of.

The cost of wiring a new house properly is, after all, very little, compared, for example, with the plumbing work in the home; it is a very small expenditure and yet it is something that is used every hour of every day in the year. In addition to that there is the added value of a proper electric installation, if one wishes to dispose of his home. It enhances the selling price many times the initial cost of the installation.

Ladder feet should be renewed when worn, or otherwise kept in proper condition in order to perform their proper functions. Spiked feet will wear and lose their sharpness. Suction-grip feet depend on an even contact of their bottoms surrounding the recessed portions so as to exert a suction effort; accordingly wear and damage resulting in unevenness may soon destroy their effectiveness. Lead coated feet may wear or become smooth and offer less slipping resistance. Abrasive-studded feet have particles of abrasive broken off or may become clogged with foreign material and thereby lose their effectiveness.

The semi-annual fall meeting of the American Gear Manufacturers' Association will be held in the Powers Hotel, Rochester, N.Y., October 13, 14 and 15.

# A House Well Planned and Well Wired — This is a Complete Layout for a Modern Home — Designed by Ontario Association of Electrical Contractors and Dealers



# Engineers turn to Black Base

According to the "Highways Information Service." New York City highway engineers who are striving constantly to perfect more economical and lasting types of pavement are reverting to a type laid in the Eastern states as far back as forty years ago but which has found a more comprehensive development and has entered into more general use in the Pacific coast states,—a type popularly known as the "black base" and composed of an asphaltic concrete made with broken stone and asphalt cement and laid at a thickness of from two and one half to four inches.

This type of construction recently was adoped as the standard for replacements, of foundation cuts on Fifth Avenue by Clifford Pinckney, chief engineer of Manhattan Borough, New York City. Every twenty-four hours 350,000 vehicles pass over this sheet asphalt pavement, one of the finest paved thoroughfares in the world. The pavement on this avenue is cut open, on an average, every forty hours for the repair or extension of the city's many underground lines of communication or service. The base under the sheet asphalt surface of Fifth Avenue as first constructed was of portland cement concrete. Hereafter, however, every opening in the pavement will be restored with the "black base". This type of base has been selected because traffic is interrupted only during its actual construction while the former type of base necessitated closing the repaired section to traffic for as long as seven days in order to give it time to set or harden. Other qualities of the "black base", according to engineers, are its firmness and resilient nature, its ability to expand and contract without cracking, its waterproof nature and its resistance to the heaviest traffic impact. Because of its flexibility, they say, it maintains contact with the under-lying soil and therefore retains its supporting value at the maximum. These qualities, it is held, give it a decided advantage over a rigid base and do not necessitate its construction in heavy thicknesses or its reinforcement with steel. It possesses further advantage, according to engineers, over a rigid base because it merges with the surface of the highway and forms a homogeneous slab, while the hard, rigid base forms no bond with the surface, and emphasizes surface tendencies to wave or crawl. The "black base", is claimed to be adaptable to any type of surface, including granite block, wooden block and brick.

### Cost of Concrete Roads in Pennsylvania

The Pennsylvania State Highway Department has opened bids for the construction of about sixty miles of new concrete highways. On the twenty-seven projects 220 contractors submitted bids. On one four-mile project seventeen bids were received. Another drew sixteen bidders and a third fourteen bidders. The total low bid approximated $3,200,000, or $53,333 a mile. Low bids submitted for 31.7 miles of eighteen-foot reinforced concrete pavement totalled $1,735,314, or $54,000 a mile. While on 21.7 miles of sixteen foot reinforced concrete road, the bids averaged $45,000 per mile.

Results of tests just concluded by the United States Bureau of Public Roads at its Arlington, Va., experiment station to determine the effect of wear upon granite block, and vitrified brick pavements show, according to the official report, that bituminous filled granite block pavements will resist the impact produced by heavily loaded steel-tired vehicles fully as well as cement-grouted pavements and that bituminous mastic fillers are as satisfactory for this kind of traffic as straight bituminous fillers. The tests also demonstrated that irregularities of surface or other factors producing impact are more serious with grouted than with bituminous filled pavements. Tar and tar-mastic fillers, it was determined, form more rigid slabs in cold weather than asphalt and asphalt mastic and consequently a brick pavement filled with the tar or tar-mastic tends more to shatter than those filled with asphalt. The tests consisted of operating a carriage carring five one-thousand pound cast-iron wheels back and forth over a runway two feet wide and four hundred feet long, containing forty-eight sections of pavement of different types. The failure of several of the concrete sections was due to tranverse cracking and settlement, accompanied by increased impact. The observations tended to indicate that slag, sandstone and limestone do not offer as much resistance to cracking as gravel, traprock and gneiss. The absence of complete data as to this phase of concrete construction, however, prevented the investigators from determining absolutely the extent to which resistance was offered by these materials.

## "Fire Stops" in Frame Houses

National Fire Prevention week, beginning October 9, is of particular interest to the large proportion of our people who occupy frame houses and who naturally think of this type of home construction as carrying an unusual fire hazard. Thousands of people are today planning home building. Naturally the foremost considerations with a majority of these men and women are economy, utility and beauty. Some are hesitating because, while they much prefer building of wood, because it is the cheapest as well as the most mobile and decorative material, they imagine that some other construction would be "fire proof."

The fact of the matter is that there is no such thing as a "fire proof" home within reach of the ordinary pocket-book, and if there were such a thing it would be difficult to build an attractive home along such lines. The best thing for anybody to do is to build scientifically and the frame house that is built right is fire resistive for all ordinary risks, and certainly carries no special hazards for the occupants, inasmuch as frame construction, as now perfected, is fully 50 per cent less liable to combustion than similar homes built ten or fifteen years ago. When the properly built modern frame house does catch fire it is almost impossible for the conflagration to spread rapidly because of the "fire stops" placed throughout the building and be cause the material which might ordinarily communicate fire to wood are properly insulated. These fire stops not only keep fire from spreading rapidly but they reduce by 50 per cent the danger of fires starting within the building itself. Such construction adds very little to the original cost of the building and gives all reasonable immunity against fire destruction. The announcement of this advanced type of frame construction, which should be vitally interesting in this era of renewed home building, is the contribution of the lumber industry to Fire Prevention week.

**A pound of high calcium lime requires from 1 to 1½ pounds of water to form a paste, or 24 to 36 gallons per barrel.**

# Mainly Constructional

**East and West—From Coast to Coast**

Mr. Alexander Fleck, president of the Vulcan Iron Works, of Ottawa, died recently at his home in that city. Mr. Fleck was born in Montreal 54 years ago.

Mr. John Cotter, superintendent of building construction for the American Bank Note Company, died at his home in Ottawa recently under conditions which have given rise to suspicions of foul play. Mr. Cotter was picked up on Wellington Street, Hull, in an unconscious condition on Monday evening, September 18, and on examination a serious wound was discovered on the back of his head, the skull being apparently smashed. The police of Hull are investigating.

Mr. William O'Brien, superintendent of government dredges in the Quebec canals, died suddenly in the Quebec canals office, 201 Inspector Street, Montreal, a few days ago, from cerebal hemorrhage Mr. O'Brien had occupied the above position for the past 17 years.

There is a possibility that a building to represent Italy, on the proposed "International Boulevard" at the Canadian National Exhibition Grounds, Toronto, will be erected. Messrs.Cavalier Giulo Ricchardi, Italian Consul-General for Canada, Mr. Jos. Glionna, Acting Vice-Consul and Chevalier Victor E. Gianelli conferred with the Exhibition Board recently with regard to the securing of a site and were assured that space would be available and that such a building would be a welcome acquisition. This brings the total of countries wishing to establish national buildings at the Fair to five; these being France, Italy, Japan, Cuba and Great Britain.

Fire losses in Canada during the week ending September 14 are estimated by the Monetary Times at $386,000, as compared with $310,000 the previous week.

The General Motors Corporation recently announced that the manufacture of the company's entire line of export models, with the exception of the Cadillac and General Motors truck, will be concentrated at the large Oshawa, Ont., plant. The reason given for this change was that with all export trade unler one head, there should result a better realization of the necessities of this end of the business and the production of a line of cars more reliable and more thoroughly tested and better fitted for export trade. The sales corporation of the export branch will also be located at Oshawa.

The completion of paving on Brock Street and Kingston Road, Whitby, Ont., will be made the occasion of a public celebration on Thursday, September 29. A half holiday has been declared and Hon. F. C. Biggs has promised to be present to address the gathering. The 48th Highlanders' Band, of Toronto, will provide the music and a community dance will be held in the evening.

Mayor Martin of Montreal, recently dug the first shovelful of earth for the excavation of the foundations of the new Mount Royal Hotel, the ceremony being witnessed by a number of officials and shareholders of the company, as well as by a large gathering of the general public.

The new Brick & Clay Products Company plant at Whitby, Ont., was recently opened by Mayor Hopper. The new industry will employ about 75 men when running at full capacity and will be under the management of Mr. J. T. Baines.

The Thompson -Starret Co., Ltd., have been incorporated, with a capital of $100,000, and will carry on the business of general contractors and engineers, with head office at Montreal.

A $2,000,000 hotel for the city of Quebec is rumored. Mr. B. N. Rosenbaum, representing certain Canadian and American financial interests, laid a proposal before the Board of Trade, which is under consideration. The meeting was unanimous in the opinion that Quebec was in need of a large hotel such as the one proposed and there is every indication that the scheme will be gone ahead with.

Mr. Tom Moore, president of the Trades and Labor Congress of Canada, sailed last Friday morning from Montreal, on the "Minnedosa", to attend the International Labor Conference to be held at Geneva, Switzerland, under the auspices of the League of Nations. Mr. Moore was accompanied by Mr. Arthur Martel, of Montreal, vice-president of the Trades and Labor Congress, who will act as technical adviser.

Honorable J. L. Perron, M. L. C., and Minister without Portfolio in the Quebec Government, has been appointed Minister of Highways, succeeding Hon. J. A. Tessier, who has tendered his resignation to become chairman of the Running Streams Commission, this latter post having been occupied temporarily since the death of Hon. S. N. Parent by Hon. Honore Mercier, Minister of Lands and Forests. The Hon. Joseph Leonide Perron, the new Minister of Highways has been a member of the Legislative Council of the Province of Quebec since April 13, 1916. He became a member of the Provincial Cabinet without portfolio, July 9, 1920. Mr. Perron, who was born at St. Marc, Que., September 24, 1872, is a prominent Montreal lawyer.

Mr. E. W. Beatty, president of the C. P. R., was one of the chief speakers at the formal opening of the Hudson's Bay Company's new $5,000,000 store at Victoria, B. C., recently.

Mr. S. Sylvestre, Deputy Minister of Public Works, Province of Quebec, for the past twenty years, resigned recently. He will be superannuated. Mr. Sylvestre's probable successor, it is stated, will be Mr. J. S. Metayer, K. C., advocate of the firm of Galipeault, St. Laurent, Gagne, Metayer and Devlin, of Quebec.

Mr. Rollo Westcott, president and founder of the R. Westcott Co. Ltd., large building contractors, of Windsor, Ont., has sold his controlling interest in the firm to Mr. E. R. Clarke. Mr. Westcott's plans for the future are unsettled. He will go to California immediately for a month's holidays, returning to Ontario at the end of that time, when he will decide on his future activities. Mr. Westcott first engaged in the construction business at Regina, Sask., several years ago, later going to Sault Ste. Marie, Ont. He came to Windsor eight years ago and organized the above mentioned firm, which has carried out a number of large works during this time, among which are noted: the Walkerville Theatre, the McGregor Building, Chalmers and Maxwell automobile plants, Leamington Water Works System and several other large public works and buildings. Mr. Clarke, who purchased Mr. Westcott's interest, is well known in Canadian contracting circles. He has been connected with the Westcott company for several months, previous to which he was a member of the Sherwood Construction Co., of Toronto.

Mr. R. J. Fleming, manager of the late Toronto Street Railway Co., has been appointed to the directorate of the Toronto Harbor Commission, to fill the vacancy caused by the succession of R. Home Smith, as chairman, to the late Mr. Lionel Clark.

Mr. Joseph S. Irvine, of Ottawa, a representative of the Canada Cement Company, died recently at the Carls-Rite Hotel, Toronto, from an attack of heart failure. Mr. Irvine was on a business trip to Toronto.

Mr. Northrop H. Bradley, prominent Toronto architect, died at his home in that city recently. Mr. Bradley was, for 25 years, connected in business with Mr. E. J. Lennox following which he held a position in the Architectural Branch of the Department of Soldiers' Civil Re-establishment. He later left the last mentioned position, to accept an appointment on the local Board of Education.

# CONSTRUCTIONAL ACTIVITY

## Period of September 28 to October 4, 1921

*Dominion Wide Service Exclusive to "Contract Record & Engineering Review"*

### Waterworks, Sewerage and Roadways

**Desbiens Mill, Que.**
Aubin & Gagne, Metabetchouan, Que., plan construction of waterworks at cost of $25,000.

**Montreal, Que.**
Construction of sewer on Kensington Ave. is contemplated by City Council. A. E. Doucet, Engr.

**Montreal, Que.**
Construction of sewer on Berri St. at cost of $28,000 is contemplated by Council. A. E. Doucet, Engr.

**Ottawa, Ont.**
Council contemplate rebuilding sewer on Emmett St. at estimated cost of $18,000.

Construction of storm sewer costing $50,000 on Harmer St. is contemplated by Council. A. F. Macallum, Commr. of Works.

Estimates are prepared for asphalt and woodblock pavement to cost $112,000 for City. A. F. Macallum, Commr. of Works.

**Pembroke, Ont.**
Plans are being prepared for waterworks to cost $10,200 for Town. S. L. Biggs, secy.-treas.

**Prince Rupert, B.C.**
City Council contemplate improvements to several streets at estimated cost of $91,000. F. S. Clements, Engr.

**Sherbrooke, Que.**
T. Tremblay, Engr., will receive tenders, no closing date set, for paving estimated to cost $100,000 for City.

T. Tremblay, Engr., has plans and will receive tenders, no closing date set, for 6,000 ft. 24 in. cast iron pipe.

**Toronto, Ont.**
Frank Barber, Engr., 40 Jarvis St., Toronto, has plans and will receive tenders until Oct. 8th for construction of 6 in. watermains in 28 streets for York Twp. Council.

**Uxbridge, Ont.**
Construction of waterworks system is contemplated by Council. By-law will be submitted to ratepayers on Jan. 1st, 1922. James, Proctor & Redfern, Ltd., Engrs., Excelsior Life Bldg., Toronto.

#### CONTRACTS AWARDED

**Boischattel, Que.**
General contract for construction of aqueduct costing $15,000 for Citadel Brick Co., Ltd., is awarded to Ulric Latouche, St. Louis de Courville.

**Hamilton, Ont.**
General contract at $355,500 for construction of storm overflow sewer for City is awarded to A. Cope & Son, 29 Albert St.

**Lac Du Bonnet, Man.**
A. Gauthier, Lac du Bonnet, has general contract grading and ditching for Municipality.

### Railroads, Bridges and Wharves

**Grand Prairie, Alta.**
E. D. & B. C. Rly. Edmonton, will erect engine house and freight sheds.

**Grimsby, Ont.**
Reinforced concrete bridge is being constructed by Town. W. F. Randall, Engr.

**Sheguiandah, Ont.**
R. C. Desrochers, secy. Dept. Pub. Works, Dom. Govt., will receive tenders until Oct. 25th for repairs to wharf. Plans with Dept., Ottawa, and Dist. Engr., Sault Ste. Marie, and at Post Office at Sheguiandah. Accepted cheque for 10 per cent. of tender required.

**Steveston, B.C.**
R. C. Desrochers, secy. Dept. Pub. Works, Dom. Govt., Ottawa, will receive tenders until Oct. 26th for construction of 3rd section of Steveston Petty. Plans with Dept., Dist. Engr., New Westminster and Victoria, Post Offices, Vancouver and Steveston. Accepted cheque for 10 per cent. of tender required.

**Waterloo, Ont.**
Construction of radial railway extension is planned by Kitchener Light Cmsn, Kitchener, Ont. Geo. Clarke, secy., Kitchener.

#### CONTRACTS AWARDED

**Carleton Place, Ont.**
Additional contracts for station costing $40,000 for C. P. Rly. are: Rock excavation, McDonell, Dibblee & Co., 43 St. Sacrement St., Montreal; steam heating, C. W. Powell, Arnprior, Ont.; slate roofing, eavestroughing and galv. iron flashings, McFarlane-Douglas Co., Ltd., Slater St., Ottawa; sash and doors, W. Nichols, Carleton Place.

**Contrecoeur, Que.**
H. Gravel, St. Lambert, Que., has general contract for repairs to wharf for Dom. Govt., Dept. Pub. Works.

**Manson's Landing, B.C.**
W. Greenlees, 407 Cordova St. W., Vancouver, has general contract for construction of wharf for Dom. Govt., Dept. Pub. Works.

**Montreal, Que.**
C. P. Rly. awarded general contract for construction of sixty miles of line to Angus & Taylor, Ltd., North Bay, Ont.

**Ottawa, Ont.**
Grant Bros., Banque Nationale Bldg., have general contract for revetment of masonry arch for Chaudiere Bridge for Dom. Govt., Dept. Pub. Works.

**Toronto, Ont.**
General contract for erection of bus garage costing $21,000 for Toronto Transportation Cmsn., Ryrie Bldg., is placed with Witchall & Son, 156 St. Helens Ave Additional contracts are: Steel, McGregor & McIntyre, 1139 Shaw St.; roofing, G. Duthie & Sons, Ltd., 650 Dufferin St.; plumbing and heating, Purdy-Mansell, Ltd., 63 Albert St.; painting, Bavington Bros.; steel sash, A. B. Ormsby Co., Ltd., 48 Abell St.

**Toronto ,Ont.**
Additional contracts for addition to car barns costing $220,000 for Toronto Transportation Cmsn., Ryrie Bldg., are: Brick chimney, Wm. Summerhaye & Sons, Rochester, N.Y., U.S.A.; tile, National Fireproofing Co., Dominion Bank Bldg.; doors, A. B. Ormsby Co., 48 Abell St.; sash, Dennis Wire & Iron Works, 36 Lombard St.; electrical, Patterson Electric Co., 43 Fermanagh Ave.; tile and terrazzo, Marble & Tile, Ltd., 19 Richmond St. W.; plastering, T. Petrie, 495 Dupont St.; painting, Bavington Bros., 2032 Dundas St. W.

**Vancouver, B.C.**
Vancouver Pile Driving & Contracting Co., 207 Hastings St. W., Vancouver, have general contract for repairs to wharves at North Gabriola Island, Hope Bay and South Pender Island for Dom. Govt., Dept. Pub. Works.

**West Vancouver, B.C.**
General contract for repairing bridge at cost of $19,000 for West Vancouver is awarded to Nickson Construction Co., Vancouver.

### Public Buildings, Churches and Schools

**Agassiz, B.C.**
Tenders will be called shortly for erection of school for Agassiz School Bd.

**Aylmer, Ont.**
A. W. Pierce, Chrm. Bldg. Committee of East Elgin Memorial Hospital Bd., will receive tenders until Oct. 12th for erection of hospital to cost $40,000. Plans with Secord & Murton, architects, 48 Home Bank Bldg., Hamilton. Surety Company's bond and marked cheque for 5 per cent. of tender required.

**Kindersley, Sask.**
Lucky Hills, S.D., No. 4452, will erect school and stable. H. M. McDougall, secy.-treas.

**Little Qualicum, B.C.**
H. Whittaker, architect, Dept. Pub Works, Victoria, will receive tenders, no closing date set, for erection of school for Qualicum School Bd. Plans with Bd.

**Richmond, Que.**
Harold Lawson, architect, 127 Stanley St., Montreal, is preparing plans for alterations to Town Hall.

**Salmon Arm, B.C.**
Plans are being prepared for high school to cost $35,000 for Prov. ovt., Dept. Pub Works.

**St. Clothilde, Que.**
Erection of school is planned by School Bd. H. Turcott, secy.-treas.

ESTABLISHED 1886

# Contract Record and Engineering Review

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## *Construction During September*

Construction activity in September, according to figures published by MacLean Building Reports, Limited, amounted to $19,565,700, as compared with $36,307,200 in August, and $20,820,100 in September 1920. The totals for the different Provinces are as follows:

| | No. of Projects | Value |
|---|---|---|
| Ontario | 959 | $9,153,600 |
| Quebec | 534 | 5,792,000 |
| Manitoba | 198 | 1,148,000 |
| British Columbia | 223 | 1,119,700 |
| Saskatchewan | 123 | 838,100 |
| Alberta | 72 | 617,400 |
| Nova Scotia | 72 | 466,800 |
| New Brunswick | 30 | 414,100 |
| P. E. Island | 3 | 16,000 |
| Total for Dominion | 2,214 | $19,565,700 |

### Large Volume of Projected Buildings

The September contemplated new construction figures of $23,256,400 are $8,223,500 greater than the August total. Some part of this marked increase can be attributed to the insistent demand for housing accommodation—741 residences, estimated to cost $4,103,500, were reported as contemplated during this month, as compared with 336 residences, costing $1,683,000, reported during August. Some relief for the unemployment situation is indicated by the fact that public works and utilities, estimated to cost $13,582,700, were reported during this month. This total represents the proposed outlay in constructing 53 bridges 11 dams and wharves, 32 sewers and watermains, 47 roads, and 18 general engineering contracts. The Dominion figures are as follows:

| | No. of Projects | Value |
|---|---|---|
| Ontario | 302 | $14,704,500 |
| Quebec | 610 | 5,795,100 |
| Western Provinces | 153 | 2,470,300 |
| Total for Dominion | 1,082 | $23,256,400 |

A survey of the figures for the first nine months of this year indicates that the building situation is gradually working itself out. As the year progresses the swing of building is more and more toward the type in which exists the more acute demand, namely residential building. Each recession in labor, materials and general building costs brings out more of the work for which there is the keenest demand. This trend toward the relatively smaller operations in residence building, in comparison with large industrial projects last year, is also reflected in decreased value of the average project. A comparative study of contracts awarded, expressed in percentages, for the first nine months of the past four years, is interesting as showing the general trend of building.

| | % 1918 | % 1919 | % 1920 | % 1921 |
|---|---|---|---|---|
| Residential | 14.6 | 25.2 | 21.5 | 31. |
| Business | 24.6 | 31.5 | 34.8 | 38.6 |
| Industrial | 41.3 | 26.9 | 25.8 | 7. |
| All other | 19.5 | 16.4 | 17.9 | 23.4 |

The feature of 1921 to date has been the relatively large amount of residential building. Business building has been proportionately active, notably in the line of schools and stores. Theatre building has been dormant, and industrial building has fallen off radically.

The value of contracts awarded throughout Canada during the first nine months of 1921 totals $185,377,800, as compared with $213,290,300 during the same period last year. However, if price recessions in material and labor costs are taken into consideration, the volume of new construction undertaken this year is about five million dollars greater than last year's total.

The consensus of opinion among architects and builders is that a steadily increasing number of business and industrial buildings will be started. A large amount of residential work can be looked for, especially in the large centres. Mortgage money plus prevailing bonuses will no doubt go down at the beginning of next year, along with general money rates. With material costs becoming stabilized and greater efficiency on the part of labor, the situation is one of promise.

## *"Penny Wise—Pound Foolish"*

"Penny wise pound foolish."

Whoever coined that phrase had a very fair idea of human nature. Interpreted literally, it means "Spending a pound to save a penny."

This is Fire Prevention Week.

But nobody knows it—at least in the Province of Ontario.

The fire loss in Ontario last year was about fifteen million dollars. A few paltry dollars, some five thousand—one three thousandth of one per cent. of the loss—was spent in telling the public about this enormous waste.

This year, to date, there is an increase of nearly fifty per cent. in the fire loss figures. Evidently the educational work has been insufficient. The public is not yet alive to its responsibilities.

So, with the biggest fire loss in the world—per capita—that is Canada's record—this year increased by fifty per cent.—the Ontario government decides to:

Do nothing whatever.

They can't afford to spend a few thousand dollars to help save twenty millions.

Is this sane government?

Is this not a "penny wise, pound foolish" policy, which ever side you view it from?

## Current Economic Conditions in the United Kingdom

General business remains inactive, and such few signs of recovery as are visible refer to future prospects rather than to actual conditions.

It is true that the returns of overseas trade for August show some slight expansion, an increase of £8,000,000 in imports and £9,000,000 in exports over July, but these are attributable to relief caused by the termination of the coal strike rather than to any revival in business. Otherwise the month's totals represent little more than half of the figures for the same month a year ago.

The re-starting of a number of factories, notably in the iron and steel industries, is certainly a favourable factor, but according to the statistics issued by the National Federation of Iron and Steel Manufacturers, while the country's production of pig-iron amounted to 93,600 tons against 10,200 in July, this compares with an outpout of 752,000 tons in August, 1920; and in this and in almost all other industries there is an enormous leeway to be made up before anything like the normal situation is reached.

### Unemployment

The unfortunate position of affairs is shown by the grave amount of unemployment which still prevails, for although the 2,170,000 wholly unemployed and 988,000 on short time, which was reported on the 1st July, has been reduced to 1,527,000 and 400,000 respectively on the 2nd September, an outstanding feature of the past month has been the demonstrations and disorder among the unemployed in their endeavour to secure relief from municipalities and the Government.

While it is generally recognized that a considerable proportion of those still unemployed consist of persons of both sexes who have lived on Government doles and done no work since the war, supplemented by a large mass of those who are averse to regular work, it is unfortunately certain that employment is exceedingly difficult to obtain and that great misery prevails.

In any case the situation has determined the Government to open an investigation which will probably lead to the institution of relief works.

Another noteworthy feature is the universal agitation against the lack of proportion between the prices which retailers are demanding for food and every kind of commodity in comparison with the manufacturers' and wholesale prices which are now ruling, and as a number of influential journals are waging a campaign against the capacity of the retailers and publishing definite figures showing the wide margin between what prices are and what they might be, it seems probable that this crusade, supplemented by the general shortage of money, must force down prices to a level which will eventually lead to a general revival in home trade.

It is now generally recognized that the present depression is intensified by the unwillingness of retailers and middlemen who have made enormous profits during the war to face reductions and losses on stocks purchased at prices higher than those which are now ruling, the consequence being that transactions are restricted in all branches of trade.

### Foreign Competition

A main difficulty towards amelioration, and particularly as regards export trade, is the fact that the question of high wages is so indissolubly interlocked with the cost of living, that upon the present scale the cost of production of almost every article in the United Kingdom is so much in excess of the figure at which they can be produced in most other countries, notably those whose currencies are depreciated, that the United Kingdom manufacturer is for the moment practically shut out of many of his customary markets.

While it is anticipated that the adoption of the procedure authorized by the Safe-guarding of Industries Act will stop the unfair dumping of certain manufactured goods into this country and thus open the way to increased employment, the problem of export trade can apparently only be solved by a reduction in the present excessive scale of wages and greatly increased production.—Trade and Commerce Bulletin.

## Bridge Specifications Analyzed by Engineering Standards Association

A joint meeting of the sub-committee on steel railway bridges and highway bridges of the Canadian Engineering Standards Association was held in Ottawa on September 12th and adjourned to Montreal on September 26th, under the chairmanship of Mr. P. B. Motley.

The draft specification for steel railway bridges was considered in relation to the provisions of the C.E.S.A. standard specification for steel railway bridges, with a view to ensuring the agreement of these specifications on all essential points and considerable progress was made in harmonizing their requirements. Among the important points under discussion were the requirements for timber and paint for bridge work, for both of which draft specifications were approved.

A panel of four members was appointed to consider the draft railway bridge specification forwarded by Mr. W. A. Duff of the Canadian National Railways, with instructions to report at the next meeting and make recommendations as to the best way of harmonizing its provisions with those of the C.E.S.A. railway bridge specification.

It was arranged to hold the next meeting of the sub-committees in Toronto during the last week of October.

*No. 64.*

# *Canada's Engineers—W. Chace Thomson*

Mr. William Chase Thomson, the subject of our sketch this week, is a well-known Montreal consulting engineer who has enjoyed a particularly wide and varied experience in constructional undertakings, notably in bridge work. A native of St. John, N. B., Mr. Thomson was born in 1866. He is United Empire Loyalist descent.

His first engineering experience was in connection with the location and construction of a short line of railway in Nova Scotia, between Oxford and New Glasgow. Subsequently he was attached to the engineering staff of the Intercolonial Railway at Moncton, where he remained for four years. At that time the late P. S. Archibald was chief engineer, and W. B. Mackenzie, principal assistant engineer.

Having become particularly interested in the design and construction of bridges, Mr. Thomson decided to specialize in that line. Accordingly, in 1891, he obtained a position with the King Bridge Company, of Cleveland, leaving in 1894 to accept an appointment with the Dominion Bridge Company of Montreal, with whom he remained until 1910—sixteen years.

Upon leaving the Dominion Bridge Company, Mr. Thomson became manager for Canada of the Cleveland Bridge & Engineering Company, of Darlington, England. Three years later this firm discontinued its Canadian office, and so in 1913 Mr. Thomson went into private practice in Montreal.

During his connection with the Cleveland Bridge & Engineering Company, some important work was carried out under Mr. Thomson's supervision. Mention might be made of the Arlington street bridge and some transcontinental structures at Winnipeg; the Queen street viaduct, at Toronto; a highway bridge for the British Columbia government, at Trail; a highway bridge over the St. Maurice River at Shawinigan Falls; and several highway bridges for the New Brunswick and federal governments.

In his private capacity as a consulting engineer, Mr. Thomson designed the Miramichi River bridge at Newcastle for the New Brunswick government. He has also served in a consulting capacity in connection with many others, including the Grand Falls and Moncton bridges.

Mr. Thomson was retained by the federal Department of Public Works to prepare plans and specifications for a bridge over the Ottawa River at Hawkesbury. In connection with this undertaking the contract for the substructure was actually awarded just before the outbreak of the war, but it was afterwards cancelled and the project has hung fire ever since.

One of Mr. Thomson's most important commissions was from the Department of Railways and Canals—the design of the three-span continuous-girder bridge over the Nelson River at Kettle Rapids, on the line of the Hudson Bay Railway. This structure, which is 1000 ft. long, with a central span of 400 ft., and two shore spans of 300 ft. each, received considerable publicity in the technical press. The Engineering News-Record commented favorably upon it in an editorial article in which it was classed as one of three notable bridges of that type then under construction.

Mr. Thomson's activities have extended to the government of Novia Scotia, for whom his most important bridges have been those of Lennox Passage and Annapolis Royal, the structure at the last-named place being now in course of erection.

Mr. Thomson is the author of the Nova Scotia Government's General Specifications for Steel Highway Bridges.

The Chateau Frontenac at Quebec City, one of the landmarks of the Dominion, is now being enlarged to approximately double its present capacity, and Mr. Thomson has been retained by the Canadian Pacific Railway for the steel and reinforced concrete design—a tribute to his extended experience and successful reputation.

Mr. William Chace Thomson

Mr. Thomson has always taken the keenest interest in the work of the technical societies, in fact in all efforts made with a view to advancing the interests of the engineering profession. For several years he was on the Canadian society's committee appointed to deal with specifications for steel railway and highway bridges a work which later was taken over by the Canadian Engineering Standards Association, who elected Mr. Thomson to the several committees on steel structures and made him chairman of the sub-committee on highway bridge specifications.

Engineering literature has been enlarged by Mr. Thomson's contributions "Bridge & Structural Design" and "Design of Typical Steel Railway Bridges" —these in addition to papers contributed to the transactions of the Engineering Institute of Canada.

Mr. Thomson is a member of the Canadian Club, the Canadian Railway Club, the Montreal Amateur Athletic Association, the Antiquarian and Numismatic Society of Montreal, and the St. Andrew Society of Glasgow.

# Construction Developments During September

## Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded—Analysis of Contemplated Construction

### *Comparative Statement of Contracts Awarded in Canada*

| According to Geographical Divisions | Ontario | Quebec | Maritime | Western | Total |
|---|---|---|---|---|---|
| September, 1921 | $ 9,153,600 | $ 5,792,000 | $ 896,900 | $ 3,723,200 | $ 19,565,700 |
| September, 1920 | 8,151,300 | 3,490,000 | 1,731,300 | 7,447,500 | 20,820,100 |
| September, 1919 | 9,778,800 | 3,461,000 | 1,167,900 | 2,422,700 | 16,843,900 |
| September, 1918 | 2,501,300 | 2,191,500 | 1,941,300 | 1,600,900 | 8,235,200 |
| 9 months, 1921 | $85,181,800 | $48,591,700 | $ 7,057,600 | $44,546,700 | $185,377,800 |
| 9 months, 1920 | 92,076,900 | 44,340,700 | 17,377,600 | 59,495,100 | 213,290,300 |
| 9 months, 1919 | 67,045,200 | 37,656,000 | 12,656,500 | 21,369,100 | 138,597,400 |
| 9 months, 1918 | 25,437,200 | 21,128,300 | 21,923,900 | 14,055,700 | 82,545,400 |

| According to Classifications or Types | Residential | Business | Industrial | Engineering | Total |
|---|---|---|---|---|---|
| September, 1921 | $ 8,116,800 | $ 8,056,500 | $ 886,400 | $ 2,506,000 | $ 19,565,700 |
| September, 1920 | 4,032,900 | 6,318,300 | 2,342,500 | 8,126,400 | 20,820,100 |
| September, 1919 | 4,917,000 | 5,661,600 | 3,422,200 | 2,843,100 | 16,843,900 |
| September, 1918 | 2,173,000 | 2,841,700 | 1,989,900 | 1,230,600 | 8,235,200 |
| 9 months, 1921 | $57,451,300 | $71,417,500 | $13,252,300 | $43,256,700 | $185,377,800 |
| 9 months, 1920 | 45,868,300 | 74,373,200 | 55,022,100 | 38,026,700 | 213,290,300 |
| 9 months, 1919 | 34,873,600 | 43,604,600 | 37,259,900 | 22,859,300 | 138,597,400 |
| 9 months, 1918 | 12,105,100 | 20,305,300 | 34,014,000 | 16,121,000 | 82,545,400 |

### CONTRACTS AWARDED ACCORDING TO CLASSIFICATIONS, JANUARY TO SEPTEMBER (INCLUSIVE), 1921

| | Ontario | | Quebec | | Maritime | | Western | |
|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value |
| Residential Buildings | 7129 | $33,072,800 | 2171 | $12,135,800 | 402 | $1,924,100 | 2534 | $10,318,600 |
| Business Buildings | 996 | 29,057,900 | [illegible] | 25,942,900 | 124 | 2,879,800 | 836 | 13,536,900 |
| Industrial Buildings | 80 | 4,339,300 | 55 | 2,351,000 | [illegible] | 290,000 | [illegible] | 6,272,000 |
| Public Works and Utilities | 376 | 18,711,800 | 201 | 8,162,000 | 64 | 1,963,700 | 231 | 14,419,200 |

### *Details of Contracts Awarded During September*

| | Ontario | | Quebec | | New Brunswick | | Nova Scotia | | Eastern Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value. | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 7 | $ 158,000 | 7 | $ 206,000 | .... | ............ | .... | ............ | 14 | $ 364,000 |
| Churches | 10 | 267,500 | 7 | 209,000 | .... | ............ | .... | ............ | 17 | 476,500 |
| Factories | 12 | 511,600 | 6 | 145,000 | 5 | $ 157,000 | 1 | $ 10,000 | 24 | 823,600 |
| Public Garages | 14 | 172,200 | 14 | 347,500 | 3 | 15,000 | .... | ............ | 31 | 534,700 |
| Hospitals | 3 | 140,000 | 2 | 100,000 | .... | ............ | 1 | 3,500 | 6 | 243,500 |
| Hotels and Clubs | 4 | 93,000 | .... | ............ | 2 | 8,000 | .... | ............ | 6 | 101,000 |
| Office Buildings | 6 | 946,700 | 1 | 20,000 | .... | ............ | 2 | 30,000 | 9 | 996,700 |
| Public Buildings | 3 | 230,000 | 1 | 28,000 | 1 | 100,000 | 1 | 15,000 | 6 | 373,000 |
| Residences | 786 | 3,416,900 | 424 | 2,198,000 | 14 | 57,000 | 60 | 263,700 | 1287 | 5,951,600 |
| Schools | 9 | 1,051,000 | 6 | 1,413,000 | .... | ............ | .... | ............ | 15 | 2,464,000 |
| Stores | 40 | 275,500 | 33 | 204,300 | 1 | 5,000 | 2 | 15,500 | 76 | 500,300 |
| Theatres | 4 | 610,000 | .... | ............ | .... | ............ | .... | ............ | 4 | 610,000 |
| Warehouses | 3 | 258,000 | 4 | 163,300 | .... | ............ | 1 | 26,000 | 8 | 447,300 |
| Total Buildings | 901 | $8,130,400 | 505 | $5,034,100 | 26 | $ 342,000 | 68 | $ 363,700 | 1503 | $13,886,200 |
| Bridges | 20 | $ 173,300 | 7 | $ 247,500 | 3 | $ 12,100 | .... | ............ | 30 | $ 432,900 |
| Dams and Wharves | 1 | 6,000 | 1 | 10,000 | .... | ............ | 2 | $ 76,100 | 4 | 92,100 |
| Sewers & Watermains | 7 | 50,800 | 5 | 210,000 | .... | ............ | 1 | 12,000 | 13 | 272,800 |
| Roads and Streets | 27 | 743,100 | 13 | 164,100 | .... | ............ | 1 | 15,000 | 41 | 922,200 |
| General Engineering | 3 | 50,000 | 3 | 126,300 | 1 | 60,000 | .... | ............ | 7 | 236,300 |
| Grand Total | 959 | $9,153,600 | 534 | $5,792,000 | 30 | $ 414,100 | 72 | $ 466,800 | 1598 | $15,842,500 |

| | British Columbia | | Alberta | | Saskatchewan | | Manitoba | | Western Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value. | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 1 | $ 7,300 | .... | ............ | 1 | $ 8,000 | .... | ............ | 2 | $ 15,300 |
| Churches | 3 | 12,600 | 5 | 151,000 | 3 | 40,500 | 5 | $ 83,500 | 16 | 287,600 |
| Factories | 1 | 16,000 | .... | ............ | .... | ............ | 2 | 46,800 | 3 | 62,800 |
| Public Garages | .... | ............ | 1 | 5,000 | .... | ............ | 2 | 21,100 | 3 | 26,100 |
| Hospitals | .... | ............ | 2 | 85,000 | 1 | 5,000 | 1 | 4,500 | 4 | 94,500 |
| Hotels and Clubs | .... | ............ | 4 | 123,000 | 2 | 4,500 | 1 | 50,000 | 7 | 177,500 |
| Office Buildings | 1 | 5,000 | 1 | 5,000 | 4 | 36,500 | 2 | 16,000 | 8 | 62,500 |
| Public Buildings | 6 | 116,000 | 2 | 31,000 | 3 | 36,700 | 1 | 2,500 | 12 | 186,200 |
| Residences | 183 | 701,500 | 42 | 154,000 | 80 | 310,100 | 146 | 620,300 | 451 | 1,785,900 |
| Schools | 8 | 64,000 | 7 | 20,300 | 8 | 86,900 | 5 | 27,000 | 28 | 198,200 |
| Stores | 7 | 41,500 | 4 | 30,100 | 2 | 19,000 | 14 | 63,700 | 27 | 154,300 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Theatres | .... | ............ | 1 | 5,000 | .... | ............ | .... | ............ | 1 | 5,000 |
| Warehouses | 5 | 28,500 | 2 | 2,500 | 5 | 46,600 | 3 | 40,000 | 15 | 117,600 |
| Total Buildings | 215 | $ 992,400 | 71 | $ 611,900 | 109 | $ 593,800 | 182 | $ 975,400 | 577 | $3,173,500 |
| Bridges | 4 | $ 60,600 | .... | ............ | .... | ............ | 10 | $ 70,900 | 14 | $ 131,500 |
| Dams and Wharves | .... | ............ | .... | ............ | 2 | $ 52,500 | 1 | 50,000 | 3 | 102,500 |
| Sewers & Watermains | .... | ............ | .... | ............ | .... | ............ | 2 | 18,000 | 2 | 18,000 |
| Roads and Streets | 2 | 25,000 | 1 | 5,500 | 5 | 161,500 | 3 | 33,700 | 11 | 225,700 |
| General Engineering | 2 | 41,700 | .... | ............ | 7 | 30,300 | .... | ............ | 9 | 72,000 |
| Grand Total | 223 | $1,119,700 | 72 | $ 617,400 | 123 | $ 838,100 | 198 | $1,148,000 | 616 | $3,723,200 |

## *Contemplated New Construction Work in Canada During September*

| | Ontario | | Quebec | | Maritime | | Western | | Dominion | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value. | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 3 | $ 70,000 | 4 | $ 200,000 | .... | ............ | .... | ............ | 7 | $ 270,000 |
| Churches | 2 | 91,000 | 1 | 40,000 | 2 | $ 14,000 | 4 | $ 60,000 | 9 | 205,000 |
| Factories | 11 | 516,000 | 4 | 75,000 | 5 | 155,000 | 8 | 332,500 | 28 | 1,078,500 |
| Public Garages | 7 | 184,500 | [illegible] | 125,000 | 1 | 8,000 | 5 | 104,000 | 21 | 421,500 |
| Hospitals | 3 | 205,000 | .... | ............ | .... | ............ | 1 | 6,000 | 4 | 211,000 |
| Hotels and Clubs | 1 | 20,000 | 1 | 10,000 | 1 | 6,000 | 3 | 130,000 | [illegible] | 166,000 |
| Office Buildings | 3 | 240,000 | 1 | 40,000 | .... | ............ | 7 | 220,500 | 11 | 500,500 |
| Public Buildings | 4 | 61,000 | 2 | 70,000 | 2 | 35,000 | 5 | 64,000 | 13 | 230,000 |
| Residences | 176 | 668,500 | 533 | 3,313,000 | .... | ............ | 32 | 122,000 | 741 | 4,103,500 |
| Schools | 14 | 1,395,000 | 11 | 299,000 | 2 | 18,000 | 10 | 68,300 | 37 | 1,780,300 |
| Stores | 10 | 124,000 | 7 | 287,000 | 1 | 7,500 | 15 | 155,500 | 33 | 574,000 |
| Theatres | 1 | 10,000 | .... | ............ | 1 | 5,000 | .... | ............ | 2 | 15,000 |
| Warehouses | 3 | 22,000 | 1 | 40,000 | .... | ............ | 5 | 56,400 | 9 | 118,400 |
| Total Buildings | 238 | $3,607,000 | 573 | $4,499,000 | 15 | $ 248,500 | 95 | $1,319,200 | 921 | $9,673,700 |
| Bridges | 10 | $ 153,000 | 7 | $ 292,000 | .... | ............ | 36 | $ 178,000 | 53 | $ 623,000 |
| Dams and Wharves | 4 | 47,000 | 4 | 55,000 | 1 | $ 8,000 | 2 | 42,000 | 11 | 152,000 |
| Sewers & Watermains | 16 | 292,500 | 10 | 204,300 | .... | ............ | 6 | 86,100 | 32 | 582,900 |
| Roads and Streets | 22 | 235,000 | 16 | 744,800 | 1 | 30,000 | [illegible] | 222,000 | 47 | 1,231,800 |
| General Engineering | 12 | 10,370,000 | .... | ............ | .... | ............ | [illegible] | 623,000 | 18 | 10,993,000 |
| Grand Total | 302 | $14,704,500 | 610 | $5,795,100 | 17 | $ 286,500 | 153 | $2,470,300 | 1082 | $23,256,400 |

# Addition to the Old Quebec Seminary

## This Progressive Institution Has Erected a Building Which Affords the Scholars the Best of Conveniences—Elaborate System of Ventilation is Adopted

The more recent addition to the several buildings occupied by Le Petit Seminaire de Quebec, some of which date back to the French regime, is an important five-story edifice forming a block of 185 feet by 63 feet. It is situated on Ste-Famille hill just behind the Seminary Church and has been erected at a cost of $400,000,00. It is now practically completed and has recently been opened to the scholars.

Besides the 16 class-rooms which accommodate 800 pupils, special lecture rooms, reception rooms and dormitories, the building contains gymnasium and recreation rooms. The students will also appreciate the large shower-bath room and swimming pool,

The plans were prepared by Mr. J. S. Bergeron, architect, 103 St-John street, Quebec, and provide for future extension. The facade, which is very fine in appearance, and all the exterior walls are made of white granite blocks from Saint Sebastien, P.Q., and of cut lime stone from St-Marc des Carrieres, P.Q. Jos. Gosselin Limited were awarded the contract for all masonry and carpentry works for $250,000.00.

The Eastern Canada Steel Co., of Quebec, built and erected the inside steel framing at a cost of $50,000.00. All the floors are of reinforced slabs and the steelwork is completely covered with concrete, while the partitions are built of terra-cotta, which makes the building absolutely fire proof.

Terrazzo was used extensively on all the floors of the class and reception rooms, etc., and was laid by the Lepage Marble Works of Montreal, while the floors in the corridors, lavatories, shower-baths and swimming pool are finished with tiles. The stairways are of slate and marble; that work was done by Jobin & Genois of Quebec.

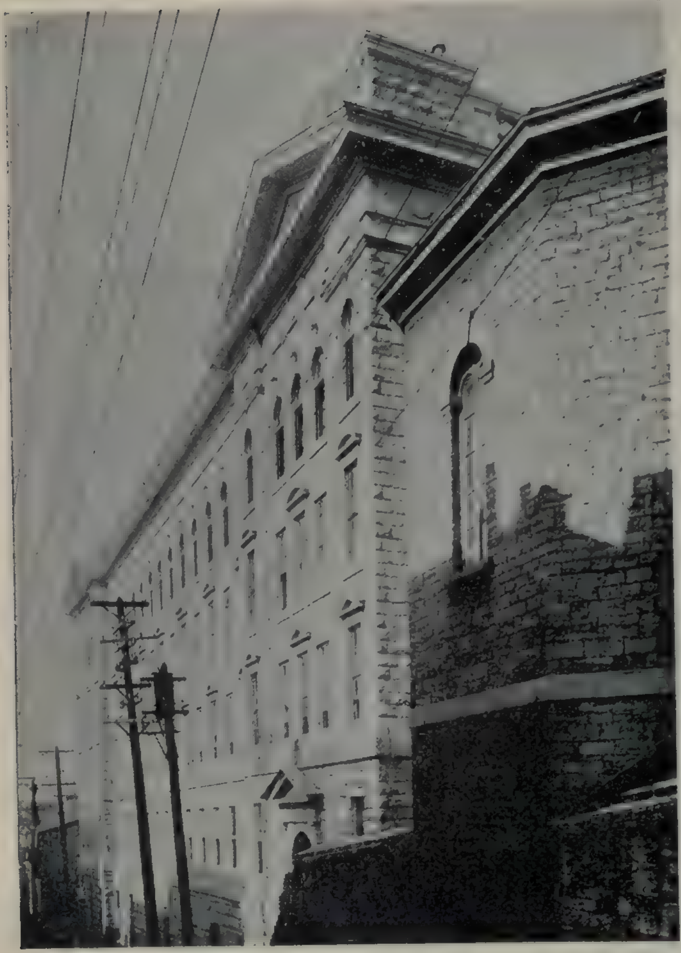
Chestnut was used for all the joinery works in the interior.

Painting and glazing were contracted by Ovide Lachance of Levis for $8,500.00.

The Barrett specifications were adopted for the roofing which was done by Napoleon Durand for the sum of $5,000.00.

The new wing is to be heated by hot water with forced circulation from the central station which already provides the heating of all the other buildings.

Ventilation has been given special attention; the system adopted was planned by the Canadian Domestic Engineering Co. of Montreal. Individual Ventilation is provided for each room. Independent devices supplied by the Univent Co,, of Moline, Ill., are located in all the rooms and are controlled by push-button switches. The apparatus consists of special fans driven by a small electric motor and is enclosed in a cabinet or a cupboard. Fresh air is drawn in through an aperture in the outside walls, is heated in



New building for Le Petit Seminaire de Quebec.

winter by a small radiator through which it passes and is then blown into the room.

This system presents the advantage of being very economical in operation since it requires little and intermittent power. The class-rooms especially, which are occupied only a few hours daily, are easily ventilated and the apparatus may be left idle when the rooms are vacant. The plumbing, heating and ventilating systems were installed by Jobin & Paquet of Quebec at a cost of $40,000.00.

## Operating Cost of Forty Drag Line Excavators

During the first four months of this year the 18 drag line excavators employed by the U. S. Reclamation Service in digging irrigation canals and laterals handled 998,595 cu. yd. of excavation. The average number of shifts per month for each machine was 50 and the average yardage per shift was 401 cu. yd.; based on 1 yd. bucket capacity the average per shift was 371 cu. yd. The average time distribution for the machines shows that they were operating 72 per cent. of the time; were laid off for repairs 17 per cent., and were idle 11 per cent. The average unit cost of machine operation, as given in Engineering and Contracting, was:

| | Per Cu. Yd. |
|---|---|
| Labor | $0.034 |
| Fuel or power | .037 |
| Miscellaneous | .018 |
| Plant and equipment | .041 |
| Total | $0.130 |

Of the 18 machines four used electric power and 14 used gasoline. The averages for each class follow:

| | Electric. | Gasoline. |
|---|---|---|
| Excavation, cu. yd. | 469,373 | 529,222 |
| Operating time, per cent. | 80 | 69 |
| Repairs, per cent. of time | 18 | 17 |
| Idle time, per cent. | 2 | 14 |
| Unit costs per cu. yd.— | | |
| Labor | $0.023 | $0.045 |
| Fuel or power | .035 | .039 |
| Miscellaneous | .018 | .017 |
| Plant and equipment | .042 | .041 |
| Total per cu. yd. | $0.118 | $0.142 |

During the same period 22 drag line excavators were used by the U. S. Reclamation Service in excavating drains. Of these machines 19 operated with gasoline; two were steam operated, and one used eletric power. The total excavation by three machines was 1,184,018 cu. yd. The average number of shifts per month per machine was 116, and the yardage per shift was 462; based on 1 yd. bucket capacity the average shift output was 384 cu. yd. The average time distribution was as follows: Operating, 65 per cent.; repairs, 21 per cent.; idle, 14 per cent. The average unit cost for machine operations only was:

| | Per Cu. Yd. |
|---|---|
| Labor | $0.028 |
| Fuel or power | .024 |
| Miscellaneous | .013 |
| Plant and equipment | .034 |
| Total | $0.099 |

## Sales Tax on Sand and Gravel

The Board of Customs Commissioners have gone into the question of the sales tax on sand and gravel, and have made the following ruling:

"Owners of gravel pits, or wholesale dealers in sand and gravel, will be held strictly accountable for the proper payment of sales tax on sales of sand or gravel, on or after the 10th May last. If such pit owners or dealers collected the sales tax from their customers prior to the above mentioned date, they must remit the taxes collected to the department."

No one type of ladder foot has been found suitable under all conditions of service. Many different types have been developed and the type best suited to the service required should be chosen.

In general it may be said that for use on rough or wooden floors, ladder feet having one or more sharp spikes or having flat lead coated bottoms will be found suitable. For use on wet and relatively smooth floors, ladder feet having flat recessed rubber bottoms have been found of service. For use on concrete and rough iron floors, ladder feet having contact surfaces in which particles of abrasive substances, such as carborundum, are partly embedded, have been found suitable for use on concrete floors.

# Suspension Bridge of 1803-ft. Span from Windsor to Detroit

## An Eight-Cable Double-Deck Structure Will Ultimately Accommodate Railway and Highway Traffic—Four-Cable Highway Bridge at First

Development of the plans for the Detroit River bridge to connect Detroit and Windsor, a project that has been under consideration during the past two years, has progressed far enough to put into concrete form some of the outstanding individual features of the proposed structure. These are enumerated in an article in Engineering News-Record from which the following data are obtained. A span of 1,803 ft. center to center of towers will be required, and for this purpose a suspension bridge with unloaded backstays, carrying two decks for separate accommodation of railway and highway traffic, has been designed. The plan has been adapted to the requirement of construction in two stages, the highway deck to be constructed first and the railway deck added later together with the cables and extra stiffening-truss capacity required to take care of it. The unprecedented span length and the high load capacity necessary for the service to be carried made the design a difficult problem. Some drawings of the design prepared by Charles E. Fowler, chief engineer, and D. B. Steinman, assistant to the chief engineer, are reproduced herewith.

During the past few months the interests back of the bridge have obtained the necessary authority from Congress and from the Dominion Parliament through the granting of charters to an American and a Canadian company for the construction of the bridge. These companies have since been organized for joint action. Arrangements have also been concluded with a security brokerage house to sell the bonds and stock of the enterprise. In the meantime an advisory board of engineers has been formed, comprising George H. Pegram, Prof. William H. Burr, C. N. Monsarrat and Prof. C. R. Young.

The principal dimensions of the structure are given in Fig. 1 herewith. The towers are of steel, consisting each of four posts in the vertical planes of the four pairs of cables (one pair to each stiffening-truss). A sag ratio of one-tenth has been adopted, with stiffening-truss depth one-fifth of the span length; a sag ratio of one-ninth and a truss depth of one-sixth are being investigated for economy, deflection and general appearance of the structure. The sag in question is the mean of that of upper and lower cables. The two decks are spaced the full depth of the trusses. The lateral system has a paneling of four times the length of the stiffening-truss panel.

### Full Efficiency in Use of Material

On account of the heavy loading, special effort has been made to utilize the material to fullest efficiency by careful adaption of the unit stresses to the available strength. For the floor, normal concentrations have been taken into account, including E60 loading on the railway deck, with impact 50 per cent of that specified by the Pencoyd formula, for railway speed of 20 m.p.h.; for the major elements of the structure, a total live load of 36,000 lb. per lineal foot of bridge (24,000 lb. for four railway tracks, 5,000 lb. for two trolley tracks, and 7,000 lb. roadway and sidewalk load). This is regarded as full or "congested" loading, a condition that would

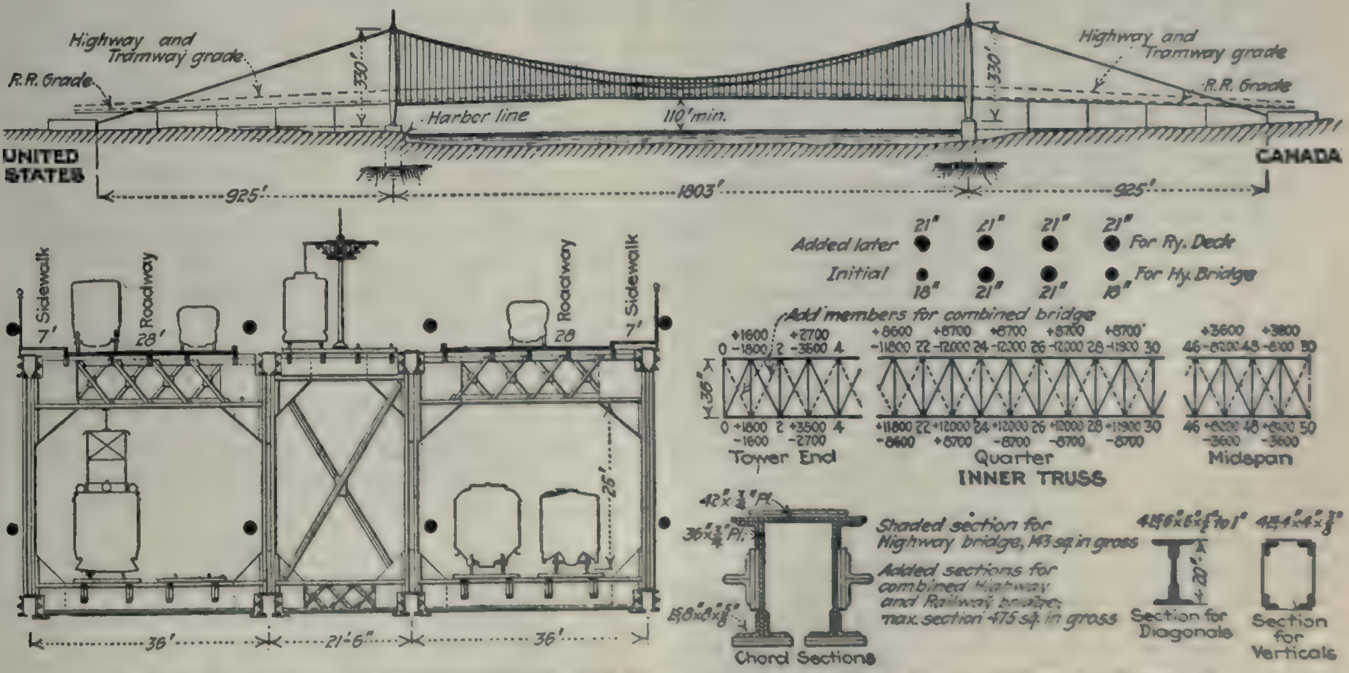


Fig. 1—Dimensions and structural arrangement of proposed Detroit-Windsor bridge—Truss reinforcement when second deck is added.

probably never be possible of realization as a test load, and to which extreme unit stresses might be applied. The normal live load, for the application of normal unit stresses, is made up of three-quarters of the congested railway load (four tracks at 4,500 lb.), 40 per cent of the trolley load (two tracks at 1,000 lb.), and half the roadway and sidewalk loading (50 lb. per sq. ft.), making a total of 23,500 lb. per lineal foot of bridge, or 65 per cent of the congested loading. Wind was computed at 30 lb. per square foot of exposed surface, including the projected surface of two trusses and train and traffic loading, a total of 1,850 lb. per lineal foot of bridge, considered as a moving load. The railway and highway floors will however absorb nearly half the lateral force. A temperature variation of 60 deg. F. above and below mean was allowed for. The suspended dead load for the design as worked out amounts to 37,700 lb. per lineal foot, of which the cables and suspenders make up 6,700 lb. and the four trusses 16,500 lb.

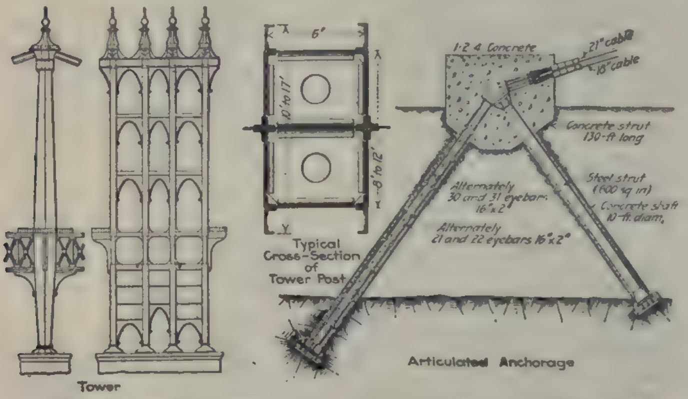

Tower
6'
10' to 17'
8' to 12'
Typical Cross-Section of Tower Post
1·2·4 Concrete
21" cable
18" cable
Concrete strut 130-ft long
Steel strut (600 sq in)
Concrete shaft 10-ft. diam.
Alternately 30 and 31 eyebars 16"x2"
Alternately 21 and 22 eyebars 16"x2"
Articulated Anchorage

Fig. 2—Portal-braced tower and strut-and-tie anchorage.

Unit stresses have been applied as follows, the two stresses given being in each case extreme and working, respectively: Cables, 100,000 and 85,000; suspenders, 50,000 and 40,000; alloy steel for towers and trusses, 45,000-150 l/r and 30,000-120 l/r; structural steel, 20,000-80 l/r. The extreme stresses are to be applied to congested loading and temperature, or to normal loading with temperature and wind. The working stresses are to be applied to normal load and temperature, or to empty bridge with temperature and wind.

Eight cables proved necessary primarily because of the long span and great load. Cables of 21 in. diameter were considered the largest practicable for construction and efficiency. However, this arrangement also afforded a ready solution of the problem of two-stage construction. Six of the eight will be 21 in. in diameter, containing 7,980 parallel wires each, of 0.192 in. diameter, galvanized. Two of them will be 18 in., with 6,700 wires of the same size. Wire of 215,000 lb. ultimate and 70% elastic limit was counted on, though material of about 10% higher elastic value may be obtained. The cables are to be continuous from anchorage to anchorage, and to be wrapped with No. 9 soft annealed galvanized steel wire; the suspenders will be pairs of galvanized-wire ropes 1¾ and 1⅞ in. diameter. Maximum cable stress amounts to 19,700,000 lb. for a 21-in. cable, under normal load with temperature.

As the development of railroad traffic arrangements and connections is believed likely to delay the realization of the project if construction to full capacity at the start is contemplated, the present intention is to build a highway bridge first, under such method of construction that only so much is built as is necessary to support the highway deck, while at the same time the additional supporting and carrying structure for the railway deck can be provided by direct attachment to the original bridge. Accordingly the design is such that the four lower cables (inner 21 in., outer 18 in.). the four stiffening-trusses, and the entire upper deck structure could be built first, but with the omission of one (of two separate) web system and of reinforcing plates of the chords of the stiffening-trusses, The second or upper set of cables would be reeved and assembled only when the railway or lower deck is required. These cables, separated near midspan from the lower ones by a height of some 20 ft., are to pass over saddles directly above the saddles of the lower cables and then run closely parallel to them along the backstay length to separate anchor chains. Anchorages, tower piers and tower are to be built of full capacity in the beginning, on account of the difficulty or impracticability of two-stage construction.

Two special elements of the structure are sketched in Fig. 2, showing one of the towers and one of the anchorages, The four posts of each tower are portal-braced instead of being connected by full diagonal bracing. Below roadway level they are braced by tranverse diaphragms. While these towers are to be built of alloy steel, the working stresses in compression will not exceed 35,000-140 l/r even under congested loading. The maximum compression in an inner tower post is 30,500,000 lb., for working live load conditions, with extreme temperature and wind action. The towers are hinged at the base to allow for movement of the saddles due to temperature change of the cables. Their weight is about 20,000,000 lb., while towers fixed at the base would be more than twice as heavy.

The stiffening-trusses were designed two-hinged for reduction of deflection and to avoid high suspender loads near midspan such as may occur with a center hinge; the weights of two-hinged and three-hinged truss were found to be about equal for the conditions of the Detroit bridge.

Unloaded backstays were used primarily on account of a curve in the railway approach, but the avoidance of large deflection in the side spans and decrease of main-span deflection were considered weighty additional reasons for this type as against loaded backstays, although there was little difference in economy between the two arrangements.

For the anchorages the novel construction sketched has been devised to provide for direct transfer of the cable pull to the underlying rock with a concrete anchorage block only heavy enough for the desired solidity of construction and for the purposes of bracing the four strut frames. This is attained by providing an inclined strut from rock up to the anchorage saddle, from which saddle (taking the pull of one upper and one lower cable) two eyebar chains pass backward and downward into a pit in the rock containing anchorage girders. Both strut and anchor chains are incased in shafts of concrete as protection from corrosion and indirectly a reinforcement of the anchorage.

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The Engineering Sales & Service Company, Ltd., Montreal, have a folder for distribution describing their heat treated bearing metal "Promet." This metal will carry a load of 9700 lbs. per square inch without distortion, wipes at 590 deg. F. melts at 600 deg. F. and has a co-efficient of friction less than 1/10 that of genuine babbitt.

# Town Planning in All Aspects

## Discussed at Conference Under the Joint Auspices of the Town Planning Institute of Canada and the City Improvement League of Montreal—Resume of Proceedings

Town planning, from its many angles, was discussed at a conference held at the Place Viger Hotel, Montreal, on September 29th and 30th and October 1st. The conference, arranged by the Town Planning Institute of Canada and the City Improvement League of Montreal, was largely attended by architects, engineers, contractors, and officials, and what is unusual in such gatherings, the interest was maintained until the last session. A feature was the note of co-operation between architects, engineers, and landscape artists in formulating town planning schemes, the idea being that each had a legitimate function to perform and that it was only by recognizing this that town planning would make substantial progress.

### Town Planning and Transportation

The majority of papers dealt with transportation in one form or another. The keynote of these papers was that it was useless to proceed with town plans unless adequate transportation facilities were provided.

There was a small exhibition of town plans of European and Australian cities, and also of suggested improvements in several Canadian towns and cities, including those for Ottawa, designed by the Ottawa Plan Commission.

The proceedings on September 29th were conducted in French, Dr. E. Deville, president of the Town Planning Institute, presiding. Practically all the papers dealt with Montreal conditions and problems. Thus Mr. G. R. MacLeod, engineer of technical services for the city, read a paper on the "Principal Arteries of Montreal," in which he outlined some of the prime factors to be considered in the laying out of any general plan, citing well-known local thoroughfares to illustrate his points. Mr. A. J. Lavoie, president of the Lavoie Automotive Device, Limited, presented two plans of Montreal, one as it is now and the other as he considered it should be. Special points advocated were the abolition of all level crossings and the creation of arteries.

Dr. L. A. Herdt, professor of electricity, McGill University, described the electrical conduit system of Montreal, stating that 1,800,000 feet of conduits and 750 manholes, covering thirteen miles of streets, have been constructed. There are 125 miles of cable installed. Mr. P. Seurot, chief engineer of the tramways commission, spoke on the relation of tramways to city extension. Other papers were "Congestion in the Towns" by Mr. A. Cousineau; the "Subsoil of Montreal" by Mr. A. Mailhiot, and "The Automobile and Urban Development" by Mr. J. A. Duchastel.

Mr. Walter J. Francis presided at the morning session on February 30th, and stated that Canada was now suffering from past errors in the matter of town planning, particularly in the matter of the adoption of the rectangular plan. He urged co-operation between engineers, architects, and others in carrying out plans.

Mr. H. L. Seymour, Toronto, in a paper on "The Tenure of Land and Its Effects on Town Planning," pointed out that the fundamental problems of town planning were land problems, the planner being oppressed with evils of land speculation and the concomitant evil, the holding of valuable land without use. The criticism of settlement in Canada must be that they allowed settlers to go practically wherever they wanted to and then tried to answer their demands for adequate transportation and the amenities of civilization. Further, people had been allowed to settle where it was impossible for settlement to be successful. Surely conditions could have been attached to holding of land that would have made big expenditures and waste of life impossible. The town planner's way was surely that of developing one area or district before another area or district is opened up for settlement. Mr. Seymour emphasized the following points: There could be no improvement, which had been intelligently planned and executed, which would not result in some local benefit; that where there was local benefit there should be local assessment; and that any civic improvement, intelligently planned and executed, would result in an increase of land values due to such improvement at least equal to and generally more than sufficient to meet the cost of that improvement. The speaker also discussed the question of the taxation for such improvements, and asserted that six per cent, which might be taken as a fair rental value, under present methods would easily meet the cost of any improvement. Such a permanent tax would permit of the elimination of other sources of revenue, such as taxes improvement, income and business.

### Value of Union Terminals

Discussing the "Economics of Organic Planning," Mr. Noulan Cauchon, chairman of the Town Planning Commission of Ottawa, asserted that duplication was economic waste. To minimize duplication in transportation, he favored the application to cities of the principle of union terminals. Mr. Cauchon showed a large number of slides in illustration of his remarks.

Mr. J. E. Vanier, president of the Association of Architects of the Province of Quebec, presided over the afternoon session, when Mr. Ramsay Traquair, professor of architecture, McGill University, described by means of several slides, the growth of the city of Edinburgh. He pointed out that Edinburgh, like many other cities, was suffering from mistakes made in the last century. It was gradually supposed that our large cities would continue to grow, but he questioned whether the tendency would not be in the direction of smaller cities.

After a paper on "Parks and Park Systems," by Mr. F. G. Todd, Montreal, Professor Percy Nobbs read a paper on the "Relation of City By-Laws to Town Plans." His remarks, he said, were intended to aid in the definition of a principle—a very important and altogether practical principle or basis of action, if town planning was ever to get beyond the stage of lectures and drawings. He meant the embodiment of the town plan intentions in the city by-laws in such a way as to induce the proper growth of comely buildings. In the development of town plans, it was unavoidable that ten-storey blocks should strike root amid the three-storey houses. They had heard something about zoning, and he thought that every one realized the importance of inducing residental, business and factory development not to interpenetrate unduly. What he had in mind was not the mere incorporation of zoning regulations as part of the city bylaws, but the better regulation of building within areas where change was going on. He did not know whether the fact that their city by-laws were in perennial state of revision was a matter for regret or satisfaction. Building by-laws, from their very nature, must always be in a state of revision. There were, however, possible advantages to be derived from the promulgamation of the work of the revisers at intervals, although it was of course obvious that what was saved in printing might be well spent in the cost of revision.

"Let us take a case in point," stated Professor Nobbs, "and assume that we all understand the working of the law (the old law conceived for three-storey houses) in the matter of windows overlooking adjoining property when six French feet away from the boundary, with the corollaries that the distance is measured to the centre of the opening in the case of obliquely set windows, and that a window set at right angles to the boundary (as in a small well) may approach to the boundary line as clearly as construction will allow. When applied to ten storey buildings, this law becomes a "reductio ad absurden" and a negation of the human rights of adjoining proprietors, passers-by and future generations.

"The case of some of the recent apartment houses not in the congested slum areas, but upon the most fashionable streets—illustrates this point. A few feet of stone facade is no palliative, but rather an aggravation and an exaggeration of the offence of mighty brick flanks which may deform whole streets and districts for a score of years or more, till built against.

### Rational System of By-Laws

"A rational system of by-laws to meet the case of ten-storey and the now permissible sixteen-storey buildings would provide for setting back from the boundaries above the three storey level and for the use of homogeneous material on flanks, rear and front, in cases where it was obvious from the nature of things that going up ten or more stories on one lot would discourage a similar operation on the adjoining one until the whole district had degenerated into a slum or become commercial. Ottawa is made hideous and ludicrous by the real estate development immediately to the south of the Parliament Buildings, which renders the terraces and open spaces of the Parliament group an unpleasant place for anyone with architectural senses, but that development is mercantile. If apartment houses of the type recently evolved are to become common in Montreal, a vast slum problem will be prepared for the next generation to cope with, for such apartment houses are not readily convertible to loft or office purposes.

"I take the view that quite as much can be done for the sane development of a city by foresight in the building regulations as by actual planning. For half a century and more, Montreal has been land poor and that is at the bottom of such anomalous construction as I have referred to. But it is quite easy to get rid of land poverty by judicious restriction of building. We are at the stage where writing off is an economic duty. If we have to write down our railway expenditures in the common interest, there is surely no reason why we should not be asked to write down our land valuations, which is what the public consent to more reasonable building regulations amounts to."

In the evening a public meeting was held at which Mr. James Ewing, Montreal, read a paper on "The Montreal Situation with Regard to Town Planning."

Mr. W. F. Tye, formerly chief engineer of the C.P. R., gave a short address on the railway problem in relation to the city, after which a resolution was passed urging the municipal authorities and provincial government to create a town planning campaign and secure a comprehensive plan of development for the island of Montreal.

At the concluding session on October 1st, Mr. F. Stuart Williamson spoke on "Rapid Transit in Relation to City Development." He pointed out that rapid transit was one of the chief factors in city development, and advocated an underground railway and motor bus system for Montreal. Mr. D. H. Nelles, supervisor of topography, geodetic survey of Canada, read a paper on city mapping with reference to surveying by aeroplane. He described, by the aid of lantern slides, the making of plans from photos taken from aeroplanes, and remarked that the making of maps was an important element in town planning. So far the work carried out had been largely experimental, but it gave promises of very important results.

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## Exposition to Stimulate Building

The American Building Exposition, sponsored by the Builders' Exchange of Cleveland, Ohio, and scheduled to run for eleven days, will be opened in the new $5,000,000 municipal auditorium of that city on January 4th of next year. Planned along the lines of London's biennial Ideal Home Show it will depart radically from the usual exposition in that it will not be for profit. Earnings will be rebated pro rata to the exhibitors.

Both the exposition hall and the auditorium proper will be utilized. The latter, with its ceiling height of 60 feet, will be used exclusively for structural materials, landscaping, financing, engineering, architecture and real estate. The exposition hall will house exhibits of interior trim, decoration, equipment, and in fact all that goes within the home or commercial building, together with contractors' machinery and equipment.

The animating idea behind the exposition is to increase and stimulate building interest during the coming year. Cleveland is woefully short of houses sufficiently adequate to house her people in comfort; some 15,000 houses short according to a report of the mayor's housing committee. The county auditor reports that more than 90,000 vacant lots are in the hands of individual owners. Last year the investment in new buildings exceeded $78,000,000. Lately there is a growing improvement in building spirit and this exposition is calculated to start the spring season in full swing.

Incidental to the exposition there will be a number of conventions drawn expressly on its account. Definitely announced so far are those of the Associated General Contractors, the National Federation of Construction Industries and the Ohio Association of Builders' Exchanges.

# Character in Design of Parks

## A Matter in Which the Landscape Architect and, to a Certain Extent, the Engineer Can Find Scope for Ingenuity—Examples of Parks with Character

**By FRED G. TODD, Landscape Architect, Montreal, before the Town Planning Convention.**

Definite outstanding character is as pleasing in a park as in the human individual, in the magnificent public building or the private house. We may not understand just why it is pleasing but we know that we find one park interesting and delightful and another monotonous.

The individual characteristics of a park may be ruggedly picturesque, pastorial, or gardenesque or a combination of all these and they may be obtained entirely by artificial means as is the case with many of the beautiful parks of Paris and other parts of Europe, or they may be largely natural as are the most of our beautiful parks in this country.

To prepare a proper design for a large park one must examine and study every natural feature, he must live with the problem until he not only absorbs all its natural beauties, but until he has made himself familiar with all the requirements and demands which will be made on the park presently and for some time in the future, for upon our skill in the development and utilization of these natural features and their successful co-ordination with the practical requirements of the public who are to use the park, depends the question of whether our design is good or bad.

### Examples of Well-Designed Parks

To place this more concretely before you I would like to mention briefly three parks having very different natural characters.

Assiniboine Park, Winnipeg. The problem here was to make 300 acres of level, rather uninteresting land along the Assiniboine River beautiful, interesting and useful to the public. No outstanding natural features were present except the vast openness of the place, and a fairly interesting well wooded river bank. It was felt that to try and develop the entire park with trees and shrubs was hopeless, and it would be equally monotonous. Therefore the main entrance to the park was decided upon and immediately inside about ten acres was laid out in a very formal manner. Two straight parallel drives were laid out the whole length of the formal garden with a panel of turf between, in the centre of which was a long pool of water, to give reflection and increase the beauty of the vista from the entrance. These formal drives come together and terminate in an elevated terrace at the end of this formal section of the park, and from this terrace curving drives depart from both sides. The visitor to the park thus passes through the entrance and is immediately confronted by a striking vista down the large panel to the terrace; he then passes into the formal section in which the gardener's art is utilized to the utmost to produce masses of brilliant flowers and foliage, and his attention is confined to this area by formal lines of trees. Passing through this formal display he arrives at the slightly elevated terrace where in distinct contrast he sees spread out before him a hundred acres of open land, a veritable prairie, bordered by irregular masses of trees through which glimpses of the curving drives, which wind about the park, may be had. This contrast helps to make the vast open stretches of the park, which is a feature of this part of the country, interesting. Advantage was taken of other natural features along the river, but they are only of ordinary interest.

### Historic Associations Maintained

The National Battlefields Park at Quebec presented quite a different problem but one of rare interest. With a diversity of views unparalleled for beauty, extent and interest, and with a wealth of historical associations, unequalled anywhere on the continent, there was no lack of interesting features to develop. The really great thing about this park, however, which appeals to almost everyone is its connection with the great historical events of our country, and the whole design of the park has been with the idea of preserving these old battlefields, and making them accessible and interesting to the public, which in this case includes the citizens of all countries who have heard of Wolfe and of his wonderful courage and perseverance. Unfortunately the war stopped work on a most important portion of the park, that nearest the Citadel, and the old Ross rifle factory still injects its ugliness into the beauty of the park, but these things will pass with time, and as the largest anl most expensive portion of the park is finished, I hope that in the not very far distant future it may be completed, for it is the one park which must appeal to everyone in Canada through its associations with the early history of our country.

### Natural Beauty Emphasized

Two years before the war the firm of Bowring Brothers of St, Johns, Newfoundland, made the city a present of a public park to commemorate the 100th anniversary of their firm. Although this is a small park of but 65 acres. its great naturally picturesque beauty led me to select this as the best example of such a park. In its development everything possible was done to make the park readily accessible to the public and in such a manner as to exhibit its attractive, natural features to the best advantage. A great deal of artificial work was however required on the park, the outline of streams changed, artificial falls constructed and a small lake made but all of these artificial creations will blend perfectly with the natural portions of the park when the trees and bushes planted assume their proper proportion.

Montreal does not possess a system of parks connected up with park ways and boulevards such as may be seen in many cities, but what a wonderful heritage has been handed down to us in Mount Royal Park and St. Helens Island to say nothing of Lafontaine Park, Maisonneuve Park and numerous small ones. Go where you will, the world over and you will not find another park such as Mount Royal so near a large city. Many of us here to-day will live to see the Mountain rising almost from the centre of a great city with our magnificent park elevated five hundred feet above the noise, dust and impure air of the city street. Perhaps then we will appreciate more fully its wonderful value, for it is not appreciated, or made use of to-day as it should be, largely owing to the utter lack of proper transportation facilities.

I have no sympathy with those who would keep the tramways or other public service companies from doing their duty to the public by giving cheap and efficient transportation to the top of the mountain and well within the park. Let us by all means regulate them and preserve with the utmost care the glory of our wonderful Mount Royal Park. Let us accentuate by suitable development its rugged picturesqueness, and its marvellous sylvan beauties, but let us above all things make these beauties and the healthy, invigorating mountain top easily accessible to the weaker ones of our city, for a park is only of greatest value if it is available for use to the great majority of the public and to those who need it the most.

# Six Lines of Defense for Protection of Water Supplies

## How to Select Those Precautionary Measures that Will Give the Desired Security With the Least Cost and the Least Duplication

By ALLAN HAZEN, Consulting Engineer, New York, before New England Water Works Association.

I am going to speak about the relations between water supply and disease, and about what is done to keep public water supplies from carrying disease, and from ever being in a position where those who take the water may have well grounded anxieties as to the safety of the supply. I propose to discuss this matter in very general terms, and with particular reference to the developments of the last few years, that have put at our disposal new and most useful methods of control.

The question now presented is not so much how to keep our water supplies free from disease-producing qualities, for that question has been answered; but rather to see what precautions may best be taken to secure safety without duplicating to an unreasonable extent parallel lines of defense when this involves added cost and an unreasonable burden on the people who pay the bills.

The following are six lines of defense: (1) Ownership and (2) sanitary supervision of catchment areas; (3) treatment of sewage from towns on catchment areas; (4) water purification by natural agencies—storage; (5) filtration, including pre-sedimentation and coagulation; (6) disinfection.

We need to know how to select those lines of defense that will give us the desired security with the least cost and with the least disturbance to existing desirable conditions. Often the answer will be found in the application of several lines of defense. For instance, taking the first one enumerated above—it will be worth while to buy and control, as completely as ownership gives control, certain parts of the catchment area. These parts will naturally be the areas along the streams and near the intakes and about the reservoirs. They may also extend to areas which, because of topography and other conditions, are more than usually favorable for future occupation and pollution. The cost of the land must be considered. It will be worth while to buy large areas of cheap wild land. It will not be worth while to buy highly developed property that has been arranged to prevent pollution. Much protection may be secured by ownership, even though only a fraction of the whole catchment area is acquired.

Storage in large reservoirs often or usually helps in maintaining the safety of the supply, but it is not to be depended upon at all times. It fails to be reliable when heavy rains follow droughts that have depleted the reservoir. It has been one of the great elements in maintaining the sanitary quality of some of our supplies even though it is not efficient at all times. It is efficient most of the time, and the existence of storage on some of our larger water supplies has been a potent influence in reducing any disease-producing qualities which the water might otherwise carry.

### Filtration and Disinfection Alone not Sufficient

The progress that has been made in the last decades in filtration and disinfection has been so great that the idea has sometimes been expressed that with such treatments it is no longer necessary to keep up other lines of defense. It has been thought by some that it was unnecessary to purchase lands on catchment areas for protective purposes, and that it would even be possible with the filtration of the water to sell great areas of such lands previously purchased. It has been suggested by others that sanitary supervision of the population on catchment areas could be reduced or elimated when the water was filtered. Such ideas can hardly be accepted as representing sound judgment. The protection afforded by filtration and disinfection may be made very complete; but new discoveries are constantly being made, and new points of view are reached as more is known. The importance of each new advance is apt to be exaggerated at the time. Subsequent experience often shows unexpected drawbacks. We do not even know about all of the disease-producing qualities in water well enough to be sure that all of them are eliminated with the bacteria that we count, and on which present judgments of the efficiency of the processes are mainly based.

As chlorine kills nearly all the bacteria, we may logically let up on the rigidity of our filter requirements; but how much? Can we put the filter back to the point where it is only a rough strainer? Or is it not wiser to keep, even at added cost, the major part of the splendid efficiency that was obtained by the best filters before chlorine was used? And with these processes of filtration and disinfection in use is it not wise to retain to the full ordinary limit the sanitary supervision of rural populations developed before disinfection began? This is usually an inexpensive part of the protection and it certainly produces results in the safety of the furnished water supply.

Then there are the supplies, not very numerous to be sure, but there are very important examples, where the sanitary quality reached by the lines of defense already in use has been so high that it has not been thought necessary to use chlorine. Some of us may think, even in these cases, that the use of chlorine as insurance against remote contingencies would be worth while, but we must admit that results actually obtained without it leave little ground for criticism.

### Much to be Done Yet

The standards of quality of public water supplies have increased and will no doubt increase still further. When water that caused only a few deaths replaced water that caused a great many deaths, the improvement was so great that it seemed at first to be wholly satisfactory. As years go by, and our students and laboratory men study the cases minutely and find out what is happening, they sometimes find that conditions might be still better. Standards are given raised and still better water is demanded. The art of water purification has advanced in the last decades to meet these demands. How far it has yet to go and how the best informed sanitarians of the future will regard the qualities of water now supplied can only be disclosed by the future. It is certain that polluted waters of years ago produced more disease and more deaths than can be accounted for by present theories of water carried disease. When we have stopped the bacteria that are counted in the laboratory, have we stopped all the disease-producing qualities of the water? That is what we do not yet fully know, and until that question is answered more conclusively than it can be answered today, and more conclusively than there seems to be an immediate prospect of its being answered, we shall do well, within reason, to stick to all the approved lines of defense that are in use, and that can be economically maintained without going to unreasonable extremes.

In the meantime there is much to be done. Information is ahead of practice. There are opportunities throughout the country to secure added safety by the better application of well known methods; and it is for us to see that no promising opportunity is lost.

# Standards of Production for Plumbers

## Montreal Master Plumbers' Association Submits Schedule as Guide for More Careful Estimating and for Payment of Mechanics on Basis of Work Done

Reference was made in the Contract Record of April 6, 1921, page 335, to the report of the Montreal Master Plumbers' Association by which they determined to pay plumbers on the basis of work done rather than by a fixed hourly wage. By this arrangement it was believed that a man would be receiving remuneration according to his proficiency. In order to make the scheme operative, the Association adopted a schedule indicating a reasonable production from journeymen plumbers and steamfitters. The following memorandum gives the Association's idea of a fair day's work.

### Plumbing

Erecting cast iron underground drains, less digging and backfilling, allowing a fitting at an average of every 10 ft.: Number of feet per 9 hours—3 in.,50; 4 in., 45; 5 in., 40; 6 in., 35; 8 in., 25.

Erecting up light stacks of medium soil pipe, allowing a fitting at an average of every 10 ft.: Number of feet per nine hours—2in., 70; 3in., 60; 4 in., 50; 5 in., 45; 6 in., 35; 8 in., 25.

Erecting medium soil pipe back vent stacks, allowing a fitting at an average of every 10 ft.: Number of feet per 9 hours—2 in., 70; 3 in., 60; 4 in., 50.

Erecting wrought iron stacks of soil pipe for Durham system, allowing a fitting at an average of every 10 ft.: Number of feet per 9 hours—4 in., 30; 4½ in., 27; 5 in., 25; 6 in., 20.

Erecting wrought iron back vent pipe, allowing a fitting on an average of every 10 ft.: Number of feet per 9 hours—1¼ in., 60; 1½ in., 55; 2 in., 50; 2½ in., 45; 3 in., 40; 3½ in., 37; 4 in., 35.

Erecting upright stacks of galvanized iron water pipe, allowing a fitting at an average of every 10 ft.: Number of feet per 9 hours—¾in., 100; 1 in., 90; 1¼ in. 75; 1½ in., 70; 2 in., 60; 2½ in., 45; 3 in., 40; 3½ in., 35; 4 in., 30.

Time for roughing in a three-piece bath room, with all waste, hot and cold water, and back vent, complete, using cast iron soil pipe and galvanized iron pipe for hot and cold water, at an average distance from the stack of 3 ft.: 20 hours—man and helper.

Allow for setting up this bathroom with standard enamelled iron lavatory on brackets, standard enamelled iron bath, and low down closet combination: 15 hours man and helper.

Time for setting up same bath room with porcelain pedestal lavatory, porcelain bath, syphon W. C. with flushometer valve: 30 hours man and helper.

Time for roughing in the same bath room, using Durham System: 30 hours—man and helper.

Time for setting up the same bath room with enamelled iron fixtures, using Durham System: 30 hours—man and helper.

Time for setting up the same bath room with porcelain fixtures, using Durham System: 30 hours—man and helper.

Time for roughing in waste, hot and cold water and back vent for a kitchen or pantry sink, at an average of ten feet from the uprights: 10 hours—man and helper.

Time for setting up this sink: 5 hours—man and helper.

Allow for roughing in of waste, back vent, hot and cold water, for one pair of wash tubs, at an average distance from the connection on the drain of ten feet: 12 hours—man and helper.

Time for setting up this pair of wash tubs, from the floor line up: 10 hours—man and helper.

Allow for the roughing in of porcelain or enamelled iron slop sink on pedestal, waste, hot and cold water and back vent, at an average distance from the upright stacks of 5 ft.: 9 hours—man and helper.

Allow for the setting of same from the floor line up. 5 hours—man and helper.

All the above work is figured on the basis of the way being clear for everything, that is, thimbles and sleeves, being provided in concrete work in concrete construction, and cutting being done by others when wood construction.

### Hot Water Heating

Time for setting the different sizes of furnaces after foundation is made: No. of hours, man and helper for boilers No 1 to No. 4, 4 hours; No. of hours man and helper for boilers No. 4½ to No. 6, 6 hours; No. of hours man and helper for boilers No. 6A to No. 8, 8 hours.

Time for erecting hot water mains in pairs on ceiling only allowing for a fitting at an average of every 10 ft.: Number of feet per 9 hours—1 in., 90; 1¼ in., 85; 1½ in., 70; 2 in., 50; 2½ in., 40; 3 in., 30; 3½ in., 25; 4 in., 20.

Time for erecting branches across the ceiling and through the ground floor with valve and elbow on, the proper height to receive radiator: No. of branches per 9 hours—¾ in., 6; 1 in., 5; 1¼ in., 4; 1½ in., 3.

Time for erecting a pair of risers from 3 in. to 1 in., allowing a fitting at an average of every 10 ft.: Number of feet per 9 hours—1 in., 65; 1¼ in., 55; 1½ in., 40; 2 in., 35; 2½ in., 25; 3 in., 20.

Number of branches that can be run from these risers to the various radiators, at an average distance from the riser of 8 ft., with branches brought through the floor the proper height to receive elbow and valve for the radiator: No. of branches per 9 hours—¾ in., 6; 1 in., 5; 1¼ in., 4; 1½ in., 3.

Time allowed for setting and connecting of each radiator with an average connection of 1 in.: 1¼ hours—man and helper.

Time allowed for setting and connecting one automatic expansion tank complete: 9 hours—man and helper .

The above time allowed includes all necessary hangers on the basement ceiling, and all necessary straps and supports on risers. No cutting or repairing of passages of pipes included.

### Single Pipe Gravity Steam Job

Time allowed for erecting steam main on ceiling with a fitting at an average of every 10 ft.: Number of feet per 9 hours—2 in., 65; 2½ in., 55; 3 in., 45; 3½ in., 40; 4 in., 35; 4½ in.,32; 5 in., 30; 6 in., 25.

Time for erecting drip line back with a fitting at an average of every 10 ft.: Number of feet per 9 hours—1½ in., 90; 2 in., 80; 2½ in., 70; 3 in., 65.

Time for erecting single riser with a fitting at an average of every 10 ft.: Number of feet per 9 hours—1 in., 100; 1¼ in., 90; 1½ in., 80; 2 in. 75; 2½ in. 60; 3 in., 55; 3½ in., 50; 4 in., 45.

Number of branches that should be run from these risers to the various radiators at an average distance from the riser of 8 ft., with branch brought through the floor, the proper height to receive an elbow and valve for the radiator: No. of branches per 9 hours—1 in., 12; 1¼ in. 10; 1½ in. 8; 2 in. 6.

Time allowed for setting and connecting of each radiator: No. of radiators per 9 hours—1 in., 20; 1¼ in., 18; 1½ in., 16; 2 in., 12.

This time is all based on providing thimbles and sleeves in concrete work and the cutting being done by others in wood work.

### Two Pipe Vacuum System Steam Jobs

Time allowed for erecting pipe from the top of the boiler along the ceiling of basement, allowing a fitting at an average of every 10 ft.: Number of feet per 9 hours—2 in., 65; 2½ in., 55; 3 in., 45; 3½ in., 40; 4 in., 35; 4½ in., 32; 5 in., 30; 6 in., 25; 7 in., 20; 8 in., 18.

Time for erecting the corresponding return line with a fitting at an average of 10 ft.: Number of feet per 9 hours—1¼ in., 95; 1½ in., 90; 2 in., 80; 2½ in., 70; 3 in., 65; 3½ in., 55; 4 in., 45.

Time for erecting risers with a fitting at an average of every 10 ft.: Number of feet per 9 hours—1in., 100; 1¼ in., 90; 1½ in., 80; 2 in., 75; 2½ in., 60; 3 in., 55; 3½ in., 50; 4 in., 45.

Time for erecting return risers with a fitting at an average of every 10 ft.: Number of feet per 9 hours—1 in., 100; 1¼ in., 90; 1½ in., 80; 2 in., 75; 2½ in., 60.

Time required for erecting branches from these risers to the radiators with connections brought through floor and left at the proper height to receive elbows and valves for the radiators with an average distance of 5 ft. from the risers: 1¼ hours—man and helper.

Time allowed for the setting and connecting of each radiator: 1¼ hours—man and helper. Time allowed for connecting in the boiler room of the standard outfit comprising: 1 boiler feed pump and receiver, 1 vacuum pump with all necessary steam and exhaust connections, suction and discharge connections, at an average distance from the boiler of 20 ft. The average pipe connections will be as follows: Steam, 1 in., exhaust, 1¼ in.; cold water connections to receiver, ¾ in.; discharge from pump to boiler, 1½ in.; suction on vacuum pump, 4 in.: 60 hours—man and helper.

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## Road Improvement Under Federal Aid

Agreements have been entered into between the various provinces of Canada and the Dominion government calling for the construction of approximately 2,823 miles of improved highways under the Canadian Highway Improvement, or "Federal Aid" Act. The cost of this mileage will be $19,151,000. The Dominion aid already appropriated in connection with this program amounts to $7,700,000. Projects for the improvement, ultimately, of 17,951 miles of highways have been approved. Manitoba's program, which includes 4000 miles, is the largest, while that of Prince Edward Island, which embraces 850 miles, is the smallest. Ontario plans to spend nearly four times the money expended by Manitoba but will build less than half her road mileage. The mileage to be constructed in each province is as follows: Prince Edward Island, 850 miles; Nova Scotia, 1297; New Brunswick, 1595; Quebec, 1433; Ontario, 1824.7; Manitoba, 4000; Saskatchewan, 2500; Alberta, 2475 and British Columbia, 1977.

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The average iron wheelbarrow load of stone or gravel is about 3 cubic feet.

The average iron wheelbarrow load of sand is about 3½ cubic feet.

# "Made in Canada" Applied to the Work of the Architect and Engineer

## The Author Deprecates the Tendency to Engage Foreign Designers for Canadian Undertakings, a Policy Which Discourages the Development of the Professions in this Country

By ALFRED V. HALL, of Messrs. W. E. Harries and A. V. Hall, Landscape Architects, Toronto.

As the citizens of Canada have now been turning their eyes again to the future requirements of the country's prosperity, rather than caring for the immediate needs as they were forced to do during the war years; and as the label of "made in Canada" has a greater significance in this vision than ever before, the efforts to educate the public, made particularly by two organizations of professional men, as to what "made in Canada"means to their respective professions, should be more fully discussed and appreciated by the average citizen and officials of public and private corporations. The professions to which we refer are the two great building professions, those of the architect and the engineer. As an individual in a profession kindred to but not either of the above, the writer would like to make an analysis somewhat along the line of that which should appear to the citizen who wishes to assist in every way possible in the well rounded growth of his or her country.

In the educational program of our province and our Dominion, facilities are, and have been, provided for as full a training in the sciences of architecture and engineering as is possible. The training of the educational system can at best but lay a foundation for one practising in either profession. Supplementary to this, and equally responsible for the success or failure of the individual who has received this training, is the practical experience required to fit him to be responsible in every detail for work and expenditures entrusted to his care. The instruction which the individual receives in the Universities covers a period of usually four years, and the time that the individual finds necessary to devote to practical experience usually runs to a similar period, at least, if he wishes to lay the foundation required to enable him to take his place in the future at the top of his profession.

### What Opportunities does Canada Offer

The above is roughly the analysis that successful professional men of today must give to the student who is asking advice regarding the choice of these professions, but in order to give the student a foundation upon which to base his judgement, one must also outline to him what will be the probable demand that Canada will make for his services in either profession when the educational system and himself have made their sacrifices in time and money, and must point out the ultimate goal which he may expect to attain.

We have read with interest the outlines presented to our governments by the Associations of Architects, to the end that their profession be protected from unrestricted competition outside of the country's borders. We also have noted with interest that this was one of the big problems discussed by the Engineering Institute of Canada at their annual and other meetings.

To appreciate the reasons behind these movements, one must face the fact that many of the larger enterprises undertaken in the last decade by municipalities, namely waterworks, sewerage systems, etc. and by private interests, such as stores, factories, hotels, and theatres,. located in these municipalities, have in a large measure been planned by offices of architects and engineers who contribute little or nothing to the support of Canada. These firms are not residents of the country, and the only requirement they have to meet is that they pay a small tax not on the cost of work planned for, but on the drafting cost of the prints the prints from which the work is carried out in accordance with specifications which naturally call for materials and equipment with which they are familiar and which are not Canadian products. If this is to continue, those studying for either of these necessary professions must, if they are to complete their education, receive a part of their training from non-Canadian firms who are planning this big work, and in the course of this training, they may also find it more to their advantage to open, or become associated with, offices outside of our borders where they may compete with foreign professions on a more equal footing, and in turn handle what Canadian work they may obtain through branch offices. The professional associations in these other countries have secured recognition and the legislation regarding registration which makes it impossible or impractical for the non-resident Canadian architect or engineer to compete in their territory, or for any member of either profession, not registered, to handle any public work.

### What Incentive for the Student

If, again, the present status of the Canadian architect and engineer remains the same, and the most prominent members of the Canadian professions are forced by our citizens, to take the option of either becoming associates to outside firms or not being indentified with the best work, what incentive will there be to the student to elect either of these professions as his vocation? Or if he elects them, to spend the amount of time to thoroughly prepare himself to attain a goal in a profession from which many well qualified practitioners of today have fallen short through no lack of ability to gain it?

Even under conditions as they exist, we have yet to see ample justification in the excuse that Canadian members of either profession cannot be found who are capable of solving the largest Canadian problems. If, as is often possible, a municipality feels that it should benefit by wider experience in the solution of its particular undertaking than the Canadian engineer or architect has in the past been able to gain, why is it not logic to make the Canadian practitioner responsible for the project, insisting, if necessary, that he obtain consulting advice from whomever the client thinks is best fitted to give it. We cannot feel that such a policy would prove to be more expensive to the individual or municipality, but that it would revise the present method which gives the foreign firm premier position and place the responsibility upon the Canadian firm dependent upon Canada for support. It would certainly in a very short time make the sacrifice required of those entering upon either profession seem much more worth while, and would insure the retention in the country of the Canadian engineer and architect whom we have trained. Such a policy would also insure that, by necessity, the architectural and engineering associations would have to watch most carefully, and insure the status of their members, admitting them with such qualifications and restrictions as the discharge of this additional responsibility would suggest.

Why should we as citizens and officials so often insist that none but Canadians should fill our private and municipal offices, positions of small salaries, when we hand over the planning of the best undertakings with large remunerations, to engineers and architects outside our country, particularly when other countries are not so unwise.

## Terms of Contract for Repair of Toronto Water Intake

On September 12th, when making the monthly inspection of the old 72-inch intake pipe (which failed in 1910), running from the Toronto Filtration Plant into the lake a distance of 2,250 feet, the inspector found that since the last inspections on August 10th and 15th, the sand surrounding the pipe had scoured for a depth of about 8 feet and the intake had opened at a joint, between pipes 9 and 10, at a point about 1,400 feet from the shore, and that pipes 11 and 12, having a length of 139 feet and 90 feet, respectively, were disconnected and displaced. He at once completed inspection of the shore end of the pipe and reported the facts at 4.30 p.m. The Commissioner of Works immediately conferred with Messrs. Roger Miller & Sons, Ltd., marine contractors, and arranged that they should proceed with repairs on the morning of September 13th.

The defective pipe is one of two 72-inch conduits through which the supply is secured from the lake—the new intake being laid subsequent to 1912.

In 1910, a portion of this intake, further inshore, failed, and was relaid and reinforced with interlocking steel sheet piling on either side of the pipe and concrete filled to the top of the pipe, to a point about 1 245 feet from the shore tank. The present failure commenced about 147 feet south of this.

In repairing the break a like method of protection is to be adopted for a distance approximately 670 feet further south of the shore tank which is in turn 335 feet more or less north of the intake mouth. This, it is believed, will provide as great security as is possible in this location, having regard for the changing condition of the lake bed.

The contract which was awarded to the Roger Miller & Sons company is very interesting and the terms are embodied in a memorandum submitted to the Commissioner of Works:

"We are prepared to carry out this work on a basis of cost plus 20%, plus $50,000 for the use of the plant necessary to complete the work in the least possible time; cost to include the wages paid all men employed and the material used in connection with the work.

"We are to provide all necessary plant at our own expense, as aforesaid, and to assume all responsibility and risk in connection therewith. We are further to assume all head office and overhead expense.

"It is understood that the city will allow us to use its derrick scow without charge, and grant the free use of any yard space we may need, during the progress of the work at the John Street wharf and which the city does not require.

"Payment to be made semi-monthly by the city to the extent of 80% of the value of the work performed, except in so far as it relates to the $50,000 for the plant, which is to be paid for at the rate of $10,000 per month for 3 months and the balance upon the satisfactory completion of the work.

"This arrangement to be embodied in a contract, the terms of which are to be mutually satisfactory to the city and our company.

On this arrangement the Commissioner of Works reported as follows: "Marine work at this season of the year is hazardous and comparatively slow, owing to storms which are encountered and the impossibility of a plant working in open water under such conditions; furthermore, the progress of one day may be largely nullified by a storm on the succeeding day. It is therefore possible that the work may not be entirely complete this year.

"It is exceedingly difficult to form a fair estimate of the cost of work of this character at this season, and a very considerable leeway must of necessity be permitted because of weather and other conditions beyond human control. If the water is reasonably quiet, permitting comparatively continuous operation, I am of the opinion that the entire work may be completed for approximately $200,000, and should be finished before the end of the present year. If lake conditions, however, should prove unpropitious, it will be necessary to adopt temporary methods for securing the intake as well as may be, and to postpone the completion of the work until next Spring, which would involve additional risk.

"You will gather from the foregoing, that it is impossible to reasonably predicate an accurate estimate, inasmuch as wages, etc., continue irrespective of the weather conditions until the work is closed down for the season or completed as the case may be."

## Brighter Building Prospects in St. Thomas

Building prospects in St. Thomas, Ont., are brighter than they have been for many months according to local contractors and builders. The Ponsford Construction Company report that they have more business along the residential construction line, this fall than they have had in two or three years and the Green Lumber Company also report a general brightening up in all lines.

The reduction in building costs, including unskilled labor, has been 15 to 20 per cent. during the past few months, the contractors estimate. In some lines of lumber the reduction runs from 25 to 40 per cent. and there has also been quite generous decreases in the prices of brick, lime, glass and other material.

Cement prices have been slightly reduced but it is not expected that there will be any big decline in the cost of this commodity until the Chippawa Power Canal is completed.

Several stone and stucco houses are reported to be under construction this fall in the city and vicinity. The cost of this type of dwelling is considerably less than brick or cement and the time required to complete the building much less. Stucco is also being used to renovate a number of old houses in the city.

All the contractors and builders declare that the present is an excellent time to build. The costs are now down to a level where persons of moderate means can undertake the erection of a home. A house that last year cost $5,000 to build can now be constructed for approximately $4,000.

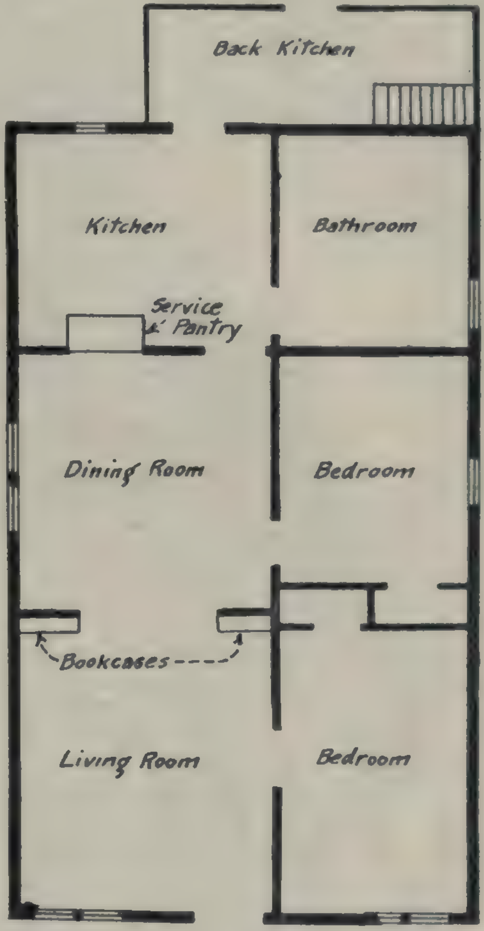
# A Small House Suggestion

## Plan of a Single-Storey Moderately Priced Dwelling of a Type that a Contractor Can Profitably Copy

The accompanying floor plan and illustration are of a dwelling of the five-room bungalow type, erected on the Massey Estate, Danforth District, Toronto, by Messrs. Young and Ronson. The company has secured a number of valuable sites on Bryant Avenue and intend erecting at least ten dwellings of the above type.

The bungalow is of solid brick construction, red pressed brick being used for the front and sand lime brick for the rear and side walls. The front entrance is directly into the living room, which is 9 feet by 11 feet, with oak hardwood flooring and fir trim. A pleasing feature of this room is the built-in book cases on either side of the double entrance to the dining room, as shown on the plan. The dining room is 9 feet by 9 feet, and, like the living room, is laid with oak hardwood floors and fir trim. A convenient feature of this room is the service pantry between it and the kitchen. The latter room is 9 feet by 8 feet 6 inches, with birch double flooring and fir trim, and enters on a large summer kitchen at the rear and bath room, 7 feet by 6 feet, with lavatory accommodation, on the right. The bedrooms, one off the living room and the other off the dining room, are identical, with the single exception that the front one is laid with oak hardwood flooring while birch double flooring is used in the rear room.

The entire layout was planned with special attention to the utilization of every available bit of space. The house is well lighted, being equipped with two large double windows of the casement type at the front, and another on the dining room at the side. These windows add considerably to the attractiveness of the exterior appearance. The other rooms are lighted by single windows. The owners intend deviating slightly from the above plan on the remainder of the houses to be erected, by making the dining room 9 feet by 11 feet instead of 9 feet by 9 feet, and the living room 9 feet by 9 feet instead of 9 feet by 11 feet, and they also intend adding another foot to the width of the bedrooms. The house is wired for electric light, is heated by a pipeless furnace and may well be designated a model home for the workman who wants a neat, up-to-date, moderately-priced dwelling.



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### Trade Incorporations

Ontario Foundation & Engineering Co. Ltd., with head office at Toronto, capital $50,000, to carry on the business of contractors builders, roofers, etc.

The Double Wall Construction Co., Ltd., with head office at Winnipeg, capital $20,000, to carry on the business of building contractors and engineers.

George J. Atwell Co., Limited, with head office at Montreal, capital $100,000, to carry on the business of builders, engineers and contractors.

Red Wing Quarry Company, Ltd., with head office at Redwater, Ont., capital $500,000, to carry on the business of quarry masters and stone merchants.

Les Construction Moderne, Ltee., with head office at Quebec, capital $20,000, to carry on the business of house builders.

Modern Homes, Ltd., with head office at Montreal, capital $40,000, to carry on the business of building contractors.

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Combustion Engineering Corporation, New York, have issued a bulletin describing the Coxe Stoker. The booklet is unusually well illustrated.

# Mainly Constructional

**East and West—From Coast to Coast**

Twenty-five business premises and ten residences were destroyed in a recent fire which occurred at Hatton, Sask., resulting in a monetary loss of between $400,000 and $500,000.

Nov. 11 next the ratepayers of St. Thomas, Ont., will vote on by-law to spend $100,000 on the erection of a Memorial Hospital.

The Concrete Pipe & Products Company, Ltd., of Hamilton, Ont., have opened an office at 736 King Street E., Hamilton, and are exhibiting a display of concrete products.

It has been announced that a new course in town-planning has been arranged for students in the fourth year, civil engineering, School of Practical Science, University of Toronto.

Building permits issued at Toronto last month totalled $1,865,522, bringing the total for the first nine months of this year to $17,721,522, or $2,244,818 below last year's figure for the same period.

A recent report states that 1,200 men will be given employment on the construction of a branch line of the C. P. R. from Kipawa, Ont., to Desquinze, Ont., 68 miles, by the contractors, Angus and Taylor.

According to figures presented at a recent meeting of the Dominion Fire Prevention Associaion, at Ottawa, loss by fire in Canada, up to the end of August is $6,000,000 ahead of last year's figure for the same period.

The contract for the construction of Toronto's "White City", along the Sunnyside waterfront, has been let, and an early start on the construction of several amusement booths is anticipated. Next summer should see Toronto's new amusement centre well under way.

The annual meeting of the Canadian Deep Waterways and Power Association will be held at the City Hall, Hamilton, on Tuesday and Wednesday, November 1st and 2nd. The report of the engineers on this project will be considered and plans for next year's campaign will be laid.

The province of Manitoba leads in housing progress. A recent report shows loans advanced by the government to the various municipalities totalling $5,000,000, and a total of 1400 houses constructed. A large percentage of this construction work was carried out in Winnipeg.

The Executive Committee of the Hudson Valley Federated Chamber of Commerce, of New York, has declared itself as opposed to the proposed St. Lawrence Ship Canal scheme. The committee protests that this project would mean the prosperity of Canadian cities at the expense of American cities.

The ratepayers of Georgetown, Ont., recently passed, by a large majority the bylaw to extend the town's wateworks system. The sum of $60,000 will be expended to procure an additional supply of water from springs on the Cleave property. It is estimated this new undertaking will increase the daily capacity by 500,000 gallons.

Hamilton's total value of building permits issued during the past month was $802,875, which shows a big increase over the 1920 figure for this month, which was $328,400. Last month's large figure brought the total for the first nine months of this year to $3,841,675, compared with $3,660,695, for the same period last year.

Building statistics at London, Ont., to end of September, this year, show the largest total for any similar period in the history of the city, the figures being $2,044,645 for 1,096 permits. The previous high mark for the first nine months was made in 1919, when the total reached $1,735,685. The total permits issued for September were 118, value $171,035.

The Bishopric Manufacturing Co., of Ottawa, have arranged to take over the entire production of the magnesite mines owned by Wilson, Paterson & Gifford, of Montreal, and will convert this product, under their own patents, into the high grade stucco, known as Firestone stucco. Magnesite stucco has been used with success throughout the United States for years, and the Quebec product has been pronounced, by Sir Mm. Fernsides, Sheffield, University, England, the greatest living authority on magnesite, to be equal in quality to the best European or California magnesite.

The officers elected for the coming year, by the Dominion Fire Prevention Association, at the closing luncheon of their annual gathering held recently in Ottawa, were:—

Honorary president, Sir Henry Drayton, Minister of Finance for Canada; President W. H. Shapley, Toronto, re-elected; vice-president, J. P. Anglin, of Montreal; secretary, G. D. Finlayson, Ottawa; executive committee, E. H. Trowern, Ottawa, Tom Moore, Ottawa, T. Learie, Toronto, J. M. Mackendrick, Galt, Ont., James Armstrong, Kingston, P. J. Jobin, Quebec, Charles Heath, Winnipeg; legislative committee, R. J. Wickman of Montreal, W. E. Long, Toronto, and E. M. Trowern, Ottawa; educational committee, John Stiles, G. F. Lewis, Toronto, and A. S. Crighton, Toronto, committee on building construction, J. P. Anglin, Montreal, Tom Moore, Ottawa, George F. Price, Toronto; committee on public fire protection, J. B. Laidlaw, Toronto, Chief Robert Burnett, Ottawa, Geo. Greenfild, Montreal; representatives on fire college committee, Prof. Alex Macphail, Kingston, J. N. Mackendrick, Galt, and Chief Robert Burnett, Ottawa.

At a meeting of directors of Canada Cement Company recently at Montreal, Frank P. Jones, vice-president and general manager of the company, was appointed to the presidency, to fill the vacancy caused by the recent death of Senator Edwards. There was another vacancy in the board caused by the death some weeks ago of J. M. Kilbourn of Owen Sound, one of the vice-presidents. In view of the elevation of Mr. Jones, this left two of the vice-presidential positions vacant. These were filled by the appointment of A. C. Tagge, an officer of the company who has been on the board for some years, and Henry Jones Fuller of New York, president of Canadian Fairbanks Company Ltd. The vacancies on the board were filled by the appointment of Gordon C. Edwards, Ottawa, and T. A. Russell, Toronto. It is understood here that Mr. Tagge will assume the general managership.

## Obituary

Major Stuart Mills Thorne, of Toronto, died in that city recently from heart trouble. Deceased was born at Lloydtown, Ont., forty-one years ago and was educated at the University of Toronto, from which he graduated with the degree B. Sc. Major Thorne joined the No. 7 Tunneling Company and proceeded overseas in 1915 and was with this company until its disbandment, when he joined the Fifth Engineers. During his military operations, Major Thorne received the decorations M. C. and Croix de Guerre. After his discharge in 1919, Major Thorne took charge of mining operations at the Golconda Mines. At the time of his decease he was in charge of the construction of a section of the hydro-electric power development canal at Chippawa.

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## *Municipal Ownership and Business Administration*

Sir Joseph Flavelle, chairman of the Board of Directors of the Grand Trunk Railway System, and Mayor T. L. Church, of Toronto, hold diametrically opposite views regarding municipal ownership of our public utilities and the purposes to which they should be put. Sir Joseph says, in a recent letter addressed to the Right Honourable Arthur Meighen, Prime Minister of Canada, that "it should be remembered that ownership by the public establishes no exemption from conditions inseparable from successful business administration. No business can survive if it is the constant target of unfavorable comment and if the management is subject to sustained critical and unfriendly examinations."

The Mayor of Toronto thinks otherwise. In his mind there is no connection between municipal ownership and business-like administration. Political exigencies stand first in His Worship's mind. The public must be pleased so that they will vote for the man who pleases them; then they will not care whether their business is properly managed or not. With indisputable proof that the cost of operation of the Toronto transportation system demands a seven-cent fare, or close to it, Mayor Church advocates a five-cent fare--because he knows the rank and file of the citizens would rather pay five cents than seven cents. It is immaterial to him--a mere detail--that this would inevitably involve a further strain on Toronto's taxpayers. It is a mere detail in his calculations that the individual tax-payer in Toronto pays more than twice as much as the individual tax-payer in Montreal--a mere detail that under his administration the tax rate in the city has increased from 19¼ mills in 1914 to 33 mills in 1921—in spite of large increases in assessments.

Nor does Mayor Church agree, apparently, with Sir Joseph Flavelle that a business cannot survive if it is the constant target of unfavorable comment and if the management is subject to sustained critical and unfriendly examinations. In one breath Mayor Church takes the credit for the municipalization of Toronto's street railway system and, in the next, subjects it to "unfavorable comment" and makes it the "subject of sustained critical and unfriendly examinations." He claims to be responsible for the appointment of the commission, gives his hearty approval to their selection of officers, and then proceeds to put every possible obstacle in the way of their performing the functions for which they were elected.

Such is municipal ownership in the city of Toronto and such, in general, is the weakness standing behind the municipalization of our public utilities. In effect, there should be no difference in the two systems except differences of minor details, only remotely associated with the management; these differences are that the money is supplied by the citizens at large, rather than by a small group, and the management is selected by the citizens at large, rather than by a small group. The underlying principles of operation remain absolutely the same and no more important statement concerning municipal ownership was ever made than that of Sir Joseph Flavelle quoted above "that ownership by the public establishes no exemption from conditions inseparable from successful business administration." In other words, the administration of a municipal utility must be businesslike. It must be developed along lines as aggressive, as sound and as free from outside interference as must the administration of any private industry.

It is doubtful if Mayor Church, and men of his type, will ever realize these facts. They are so thoroughly saturated with the idea that politics is the supreme end, and everything else in life merely a means to that end, that their influence is a factor that will always have to be contended with. There is grave danger that men of Mayor Church's type will eventually discredit municipal ownership entirely in the public mind. Unless the idea prevails that public ownership is inseparable from successful business administration, municipal ownership is doomed.

## *The Trend of Building Costs*

It is not an easy matter to answer the questions as to just how far building costs have receded, but one fact at least stands out prominently, namely, that the amount of building is not, however you look at it, greatly in excess of a year ago, over the same period. This is in spite of the fact that the demand for building, and especially for homes, is as insistent as ever. One conclusion only, therefore, can be reached: the public is not satisfied that the price of building has been reduced as much as it ought to be, or as much as it will be in the near future.

What the future will offer in the way of prices must, of course, remain largely a matter of conjecture, but an analysis in a general way of what has taken place during the past few months indicates the present status of the cost of building.

Building costs are made up of a number of factors--freight rates, money rates, cost of building materials, and wages. In spite of efforts by different organizations--efforts which are still being continued--no reduction whatever has been made in the freight rates on building materials. In view of the shortage of homes and the unemployment situation, this seems unfortunate, but the railways answer is that they must consider the proposition from a business viewpoint. They are responsible for operating the railways so that expenses shall not exceed revenue, and at the present time they cannot see that any reduction would assist in that direction.

Next there is the question of borrowing money. In this connection, there is a wide divergence in practice and very little apparent reason in the divergence The writer knows of one instance where a first mortgage carried a rate of 7½ per cent. and the second one, a rate of 7 per cent.; also of another case where the first mortgage carried 6½ per cent. and the second 8 per cent. One often hears, also, of the demand for large rebates on second mortgages, which amount to an abnormally high rate, though it may not appear on the surface. The fact is that money is difficult to get on mortgage, at any price. The reason for this lies, of course, in the excellent opportunities offering today in other fields of investment. Even Dominion bonds yield slightly over 6 per cent. and many industries, with excellent promise, some of them with dividends payable in New York, yield all the way up to 12 per cent. When one considers, in addition, the difficulty the mortgagee has in collecting his money, it is not hard to see the reason for the unpopularity of either first or second mortgages, at rates which appeal to the average house holder or contractor. This would seem to point to the urgent necessity for financial assistance either by the Dominion, provincial or municipal governments. A first mortgage at 7½ per cent and a second mortgage at eight per cent. is too big a load for the average house holder to carry and particularly the working man, whose income is subject to such incidentals as strikes and unemployment.

The next item to be considered is material costs. These enter into the construction of the building in such varying quantities that it is impossible to suggest the extent to which prices have been reduced. It may be 20 per cent.; it may be 40 per cent. It is probably, on the average, well above the lower figure. Whether the reduction in this direction has gone as far as it will do in the near future, is another difficult question. In certain cases, it is claimed that an increase in demand would immediately increase prices. In others, it would, undoubtedly work the other way. Many material houses have accepted considerable loss through attempting to turn a high priced stock over at a figure that would create a demand.

Finally, what is the labor situation? Perhaps the recession here is greater than the general public knows; it certainly is greater than labor itself will admit. Though written agreements or verbal understandings may indicate that carpenters, masons and others are receiving the same wages as a year ago, or two years ago, the fact remains that unemployment has compelled workmen to compete against one another. Carpenters a year ago were getting 90 cents, now they are glad to take 80 cents. Perhaps the biggest drop is in common labor, which is reported available all the way from 25 cents to 40 cents.

With the lower wages, there also seems to be a tendency to greater efficiency and less slacking; still there is far too much of the latter apparent. A few days ago a contractor received a letter from the owner of a property undergoing repairs, that he was pleased to see that his workmen were efficient and zealous of their employer's time. A few years ago it was the occasional slacker that brought forth a letter of protest, but in recent years we have become accustomed to this type of labor and it is the exception that now creates comment. We cannot feel otherwise than that this is still the big element in the cost of building and the big element in re-establishing the confidence of the man who has money to build with. "Labor" can do more to revive building activity than can any other section of the trade. When capital regains confidence in the sincerity of labor to do its utmost to reduce the cost of building, we are confident that much new work will be started.

### Good Wages and Free Labor

**It was pointed out recently by Governor Ephraim F. Morgan of West Virgina, in a statement in the New York Commercial, that 40% of the bituminous coal produced in this country is from mines where non-union labor is employed. He says, in speaking of the leaders of the United Mine Workers: Under the present wage scale they have found it an impossibility to lessen the tonnage from the non-union districts." After a long course of rioting and murder which received countenance or apology from the national leaders, developing into an armed insurrection which only the United States Army could suppress, these mine leaders discovered more than the governor ascribes to them, or at least would have found it if they possessed an intelligent sense of proportion.**

**They themselves had stimulated the non-union production by the encouragement of loafing, costly labor conditions and excessive wage demands among union workers. The per capita production of the non-union miner is far greater than that of the unionized worker His labor conditions are eminently tolerable, his net wages are as good or better, and he has practically continuous work against fewer days a week in the unionized districts. When will labor begin to understand that a union is a means and not an end? If the workman can secure better conditions in the open shops of the United States Steel Corporation, is it any wonder that 93% of that corporation's employees were not in sympathy with the indefensible strike of two years ago? To judge from the utterances of some labor apologists, and more particularly those who carry their half-baked economics into the pulpit, a strike is something good for its own sake and a union is an end in itself. Everybody is looking around for signs of better times. The non-unionized miner is one of them, and he is getting big wages at that.—Barron's Weekly**

### *No. 65.*

# *Canada's Engineers—J. W B. Blackman*

In studying the careers of Canadian engineers, it is remarkable to find how many of them come to this country from the Old Land, bringing with them a thorough knowledge of and ripe experience in British engineering practice, that have been instrumental in placing the cities of Canada on a high plane as far as the ability of their municipal engineers is concerned. .In this series, several city and town engineers, whose sketches have been presented, have received their insight into engineering mysteries in the Mother Land and in this particular instance it is a pleasure to present another such engineer--Mr. J. W. B. Blackman, city engineer of North Vancouver, B. C. Mr. Blackman, who has been engaged in practice in this country for the past 12 years, was born in Kent, England, in 1878, and was educated at Highbury House College, St. Leonard's-on-Sea, Sussex. After his schooling, he became assistant master at the Brighton College of Engineering and Science and was also engaged for over six years in practice at Brighton, carrying out various sewage disposal and similar schemes.

In March, 1909, Mr. Blackman was appointed city engineer of New Westminster, B. C., which appointment he held until he applied for leave of absence to join the Canadian Expeditionary Force, which he did in January 1917. During the time he was at New Westminster several million dollars worth of public works was successfully carried out, including the construction of the 25 inch steel water main from Lake Coquitlam to the city of New Westminster, also the laying of a 13 inch steel main across the Fraser River to the Richmond municipality and the building of a five million gallon reservoir. .Mr. Blackman wrote an article on this work which was published by the Institution of Municipal and County Engineers of Great Britain, for which he received the first prize. He also designed and constructed the main drainage system comprising some 50.7 miles of pipes varying from 8 inches to 78 inches in diameter.

Mr. Blackman was also engineer for the joint Burnaby-New Westminster scheme, in which a monolithic, re-inforced concrete conduit, elliptical in shape varying from 5′ 3″ x 6′ 6″ to 8′ 6″ x 8′ 6″ was constructed. .These works were completed with the exception of a few hundred feet of the Burnaby-New Westminster joint trunk sewer. When completed this project will cost $1,230,000.00. Mr. Blackman wrote an article on it which was published by the Institute of Municipal and County Engineers and for which he was awarded the first prize. In addition to the foregoing, all paved streets and sidewalks in New Westminster amounting to several miles were constructed during his regime.

Mr. Blackman took a commission in the Canadian Railway Troops in January, 1917, and was promoted to adjutant of the B.C. Company. After arrival in Great Britain he was seconded to the Imperial War Office for special engineering duty under General Sir Edwin Rabin. His first undertaking was to build a large Aerodrome consisting of some 53 buildings and costing several million dollars. This work included the building of a railway to take the materials to the works. Complete sewage disposal, water supply, and fire protection schemes were installed.

He was afterwards promoted to the chief water engineer's staff and selected to represent the war office as their expert for a special mission to France to search for water for a large American camp. After a careful geological reconnaissance water was discovered and a successful scheme was carried out upon Mr. Blackman's design. For this work he was promoted to the rank of captain and placed in consulting charge of no less than 40 military and naval water supplies scattered from the British Isles to France.

Mr. J. W. B. Blackman.

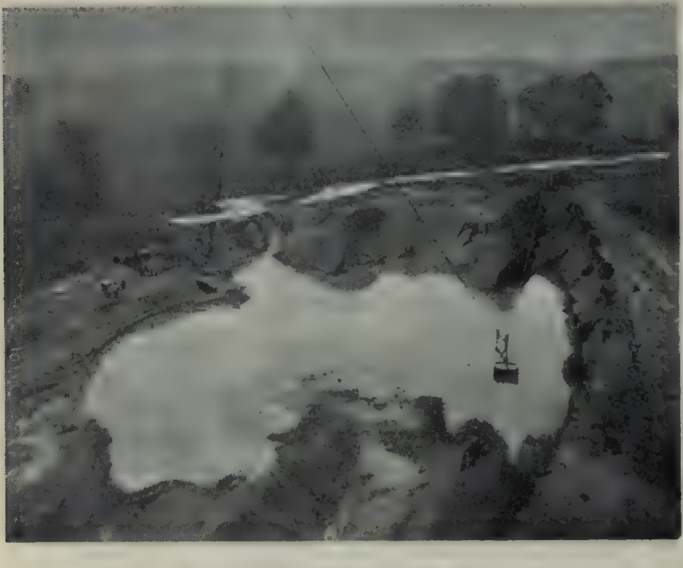
Upon return from overseas Capt. Blackman was appointed to his former position of city engineer for the city of New Westminster but accepted an appointment as consulting engineer for some special work in hard surfacing the highways for the city of Chilliwack and the provincial government of British Columbia. In March, 1920, Capt. Blackman was selected from a large number of applicants to be city engineer of North Vancouver, the position he now holds.

Mr. Blackman is a member of the Engineering Institute of Canada, a member of the American Society of Civil Engineers, a member of the Institution Municipal and County Engineers of Great Britain, and he is also a registered professional engineer of British Columbia.

# The London-Lambeth Highway

## A Six-Mile Stretch of Concrete Road, Part of the Ontario Provincial System, Built Expeditiously by Well Organized Methods —Mechanical Equipment of High Order

Running southwest from London, Ontario, to a point beyond Lambeth--approximately 6 miles--a concrete road has just been completed that is considered one of the finest units of the provincial highway system. As the main artery entering London from the west, it has been carrying very heavy traffic and with the improved service that is offered by its reconstruction, it will bear an even more intense load than heretofore. For this very important link in the 1800-mile interurban highway scheme of Ontario, the government selected cement-concrete as the desirable paving material, replacing an old gravel road that was well worn and cut up. In the construction of this highway the contractors have followed methods that resulted in its very speedy completion and which, in view of the large amount of mechanical equipment used, enabled them to expeditiously and efficiently handle all the involved operations pertaining to the construction of a good concrete pavement. This article will briefly outline the general scheme followed by the contractors--the Lumsden Engineering & Transport Co. Ltd., of Toronto--in the paving of this 6 miles during the past summer.



Gravel excavated by drag-line.

Starting at Elwood Avenue and Wharncliffe Rd., in the city of London, the new pavement follows the latter street, the first half mile being on the boundary between the city and the county. The normal width of the new road is 20 ft., but along this portion the width has been extended 5 ft. on the city side and provided with curb and gutter. The 20 ft. width obtains thereafter to the village of Lambeth, the main corners of which are about 5 miles distant from the outer limits of the city of London. The road also extends 1,000 ft. west from Lambeth, on the way to Windsor and 3,000 ft. south on the route to St. Thomas.

The road is of one-course concrete with no reinforcement except over culverts, the pavement measuring 6" deep on the sides and 8½" at the centre. Concrete culverts were built at all low points and on each side is provided a 5 ft. shoulder and the government 8 ft. by 2½ ft. standard edge. No other drainage has been found necessary except where soft spots in the sub-grade have been found, in which case the road has been undertiled at a point about one foot from the edge. For this purpose about 12,000 feet of field tile have been put in.

The bins at the gravel pit.

The new surface has been laid on the old gravel road, 3 or 4 in. of which was scratched off prior to reconstruction. The only soft spots on the road are at a small fill in Lambeth and in the half mile stretch in the city of London. In the latter case, gravel was first spread over the sub-soil before paving.

In determining the procedure to be adopted in the construction of the road, the contractors made use of the old London and Lake Erie Traction gravel pit, which is located about 3,000 ft. south of the main corners of Lambeth. This pit, which was purchased by the government, was five acres in extent and watered by a small stream at its western extremity. The contractors adopted this point as their supply centre and there established their camp.

The work was commenced at the London end, giving a maximum haul of about 6 miles, which of course was gradually decreased as the paving progressed.

The gravel was excavated at first by a ½ yd. drag-line, operated by a steam hoist, the digging taking place from south to north, with the plant operating in an easterly and westerly direction. The first cut was continued until a depth of 25 ft. below water level was obtained and the scraper got into heavy boulders and clay, when the cut was shifted. This digging outfit was later replaced by a ¾ yd. dragline operated by an electric hoist. This change was necessitated because the capacity of the original plant was inadequate.

The gravel was hoisted by the drag line to a hopper 55 ft. high, surmounting the supply bins. In the top hopper a screen separated the large stone, so that nothing over 2½ in. was retained. The boulders were deposited in a waste pile. As the gravel was adulterated with clay, it was washed on screens to which were directed two streams of water, pumped from a pit separate from the creek and main pit, so that there was always an assured supply of clean water for washing purposes. The sand and dirty water passed out through the perforations of the washing screen into a settling tank, which was so balanced that when the water attained a pre-determined height, it automatically tripped, ejecting the water and allowing the sand to be collected. The retained stone passed into the bins. From the bottoms of the bins were five measuring hoppers opening over the truck way and operated by one lever. The outlets from the bins into the hoppers were so arranged that the desired proportions of sand and stone were obtained.

Paving operations in progress

The sand and gravel batches were transported to the paving site by a fleet of 7 Packard 5-ton trucks, all of which had end dump bodies, specially fitted with pivoted partitions, dividing them into five compartments each, a compartment containing enough sand and stone for one batch of concrete. The five compartments on each truck were loaded at one time by being spotted under the measuring hoppers of the supply bins. No truck needed over a half minute to load up. The cement was also hauled from the supply centre near the pit to the job and deposited in piles about 20 ft. apart, along the road bed.

The concrete was mixed in a gas driven 14-E Koehring paving machine, which was later replaced by a 21-E Koehring machine. These were handled in all operations by one man and it is worth noting that during the whole season's work less than 6 hours' delay was occasioned, this being due solely to cable breakage and not to any breakdown of a vital part of the machine. This machine handled as much as 700 ft. of road a day and 3,500 ft. a week.

Very little road bed preparation was necessary, as the old gravel road formed a suitable foundation. Merely 3 or 4 inches was scraped off with a scarifier and grader and the foundation rolled with a steam roller. Grading operations were kept just ahead of the mixer--never more than 500 ft. in front. This was decided upon to enable the heavy trucks to work right up to the mixer during inclement weather.

Water for mixing and sprinkling was pumped by a C. H. & E. triplex pump, excepting for 2½ miles out of London, when a connection was made to the London mains. As the work progressed other sources of supply were obtained, the maximum pumpage distance being 2½ miles.

Steel forms were used for confining the concrete which was handled by three spreaders and two finishers, who used the belt and roller method of finishing the surface. An expansion joint of the Elastite type was provided every 50 ft., the surface being finished at these points with a split-float. After finishing the concrete was covered with earth from the roadside, sprinkled and allowed to cure for three weeks.

The contractors maintained a camp in the vicinity of the pit, with cook houses and camp buildings offering accommodation for 125 men. There was also a cement shed at this point with a capacity of 10 cars.

The paving operations were finished on the 6th day of October, having been started on the 17th of June. All that remains now is the ditching and work on this portion of the contract is proceeding at the rate of 1,000 ft. a day. During construction operations, all traffic was entirely detoured.

The principals of the Lumsden Engineering & Transport Co.--Messrs. L. Cummings and C. Johnston--were in actual charge of the construction and Mr.

The paving machine in action.

Roland McDonald was the superintendent. The same firm has just completed another interesting contract, of 4⅛ miles, north of Oakville, Ont., a description of which will appear in an early issue. This contract was also handled with road building equipment of a high order, all of which, it might be stated is owned by the contractors.

The road was constructed under the supervision of the highways department of the Ontario Government, and an excellent staff of engineers and inspectors were constantly on the work. The co-operation between the Department and the contractor was instrumental in securing a high type of pavement which is most creditable to both parties.

Haulage of materials was done by a fleet of motor trucks.

# Stagnation in the Building Industry from a Financial Standpoint

By W. G. Watson, Asst. General Manager, Toronto General Trust Corporation, before convention of O. A. A. & R. A. I. C.

I need hardly say that we are living in a strange new world of affairs to-day, and yet, lest we become impatient and discouraged with the processes of readjustment, we do well to remind one another frequently of the world upheaval through which we have only as yet partially passed, affecting as it does every nation of the earth. The magnitude of the war, and the far spread nature of our modern industrial life and international systems of exchange have imposed a set of conditions with which even the best minds in the world are not familiar, and left problems with which the leading statesmen, economists, bankers and business men of the great powers are still grappling, in the hope of finding some satisfactory solutions.

If the building industry has suffered, so have practically all the other chief industries in our economic fabric more or less felt the strain.

Let us also remember that while in Canada we have felt and are still feeling the pressure of economic disturbance, as shown in the number of unemployed, and the decrease in our foreign and domestic trade, nevertheless we have not suffered to the extent that many other nations have, and indeed conditions in some respects have been better here than in the republic to the south of us, notwithstanding the great accumulation of wealth in that country.

We cannot hope for a return to normal business until such time as some of the major international difficulties are settled; for instance, certain of the foreign currencies must be stabilized so as to prevent such rapid fluctuations in exchange as recently took place in connection with the German mark, a situation which makes it impossible to do business on any large scale with these countries. We cannot, of course, look for a return to par of exchange in many cases for years to come, but we can hope for some sort of stabilization.

Provision must be made for granting credits on a much larger scale to a number of the European and other nations.

Methods must be found by which inflation in certain countries, which is at the bottom of much of the instability, can be checked and finally overcome.

The solution of these international problems and others must wait, however, largely upon the great banking and business interests of the world, working in co-operation with the governments of the great powers.

There are other matters, however, to which we as Canadians, whether we represent Capital or Labour, should address ourselves, to the end that we may be ready as a nation to play our part and obtain our full share of the commerce of the world when the opportunity offers, and in the meantime to stimulate the home market so that in the building industry and other departments of our industrial life we may find work for all our people. What can we do:—

### Reduce Cost of Production and Distribution

1. We must make every proper endeavor to reduce our cost of production and distribution of commodities in general—the builder, the manufacturer, wholesaler and retailer must all agree that the day of war-time profits has passed, and if he would get back to normal conditions he must reduce his prices. In this connection it will not be sufficient that capital alone should make the effort. Labor, skilled and unskilled, will have to bear its full share for the benefit of all. Reasonable reductions from war-time wages, and greater efficiency on the part of labor will go a long, long way in creating employment for all those who are at present out of work, by lowering the cost of production, and in co-operation with capital, greatly stimulate buying on the part of the public by establishing lower levels in retail prices. Co-operation in this way will very shortly show itself in a revival of the building trade, in lower rents, and a much reduced cost of living.

In this is also involved our transportation problem, in connection with which we in Canada, as they in the United States, are paying altogether too much for the distribution of farm and factory products. Here again, labor and capital must co-operate to get the cost down for the benefit of the many.

2. In the matter of taxes, we have suffered from the excess profits tax, which left many of our large industries short of the necessary funds to properly take care of the situation that developed last year when the slump in business came. And while this tax has been discontinued, we still have in connection with our income tax act, a surtax, which has the effect of diverting from legitimate business large sums, and in losing to that extent for Canada the business experience and ability of trained men who would otherwise follow with their services and counsel the investment of such funds. I like the sentiment of an intelligent farmer with whom I discussed the tax situation

some time ago, who said:—"I believe in the broad application of a comprehensive sales tax, so that each citizen will pay according to his purchases. If I buy much, then my taxes are high; if I buy little, my taxes are low, but everyone will have the satisfaction of feeling that he is paying his full share." This form of taxation, to include retail sales, is gaining friends in the United States at the present time, where it is being advocated by many as one of the most equitable of all taxes for Federal purposes.

### On Strike Against High Cost

If we consider more closely the building industry, I think we shall come to the conclusion that the public is on strike against the high cost of construction, notwithstanding the very real shortage of dwelling houses that obtains, and the programmes of building with which many business houses and other institutions are anxious to proceed. No amount of government or other money that may be made available at attractive interest rates for building houses will induce any great body of work people, or any other class, to purchase houses at the present high cost, any more than they can be persuaded to start a buying campaign of merchandise of any sort at prices that appeal to them as being too high.

If you can get the prices down to a reasonable point, and by this I do not mean pre-war levels, I am sure there will be a ready demand for a very considerable number of dwelling houses, not only in Toronto, but in many of the larger cities of Canada. While mortgage interest rates have increased but very little since the fall of 1914, I think we have come to a place, with the American market opened for our high-class government and municipal bonds and our insurance companies' funds for investment greatly increased since 1914, where there will be an ample supply of funds for mortgage investment, and shortly perhaps, at slightly lower rates of interest than now prevail.

### Improvement in Business

Generally speaking business is a little better in a good many lines this Autumn, both here and in the States, partially due to the movement of crops, and other seasonal conditions, but we should not look for any very early boom in business. I have just come from New York, where I ascertained from bankers and others that they are not expecting any great revival in business just yet, but the signs are promising,—money is more plentiful for high-grade investments and credits easier. The building trades in the New England and other states show considerable improvement for August and September, and some of the officers in the larger insurance companies informed me they were very busy making mortgage loans. They are interested in Canada, and like our securities and I think we may shortly look for a considerable increase of American funds for mortgage investment.

As one of the allies who tried to do her duty during those long, trying years of the world war, Canada has not yet gotten back to normal conditions, and we may not for some time to come, but I want to take this opportunity of declaring my faith in the future of this land of ours, and in its people, and its institutions. I know there are a few noisy leaders among us who would like to smash our whole economic system, some of whom, I am informed, believe that since it costs no more to print a $1,000 note than a one, we ought only to print $1,000 bills. They have tried that system in Russia, and a friend of mine who came back from Europe just a few weeks ago produced from his pocket a one thousand rouble note, and said it required ten of them to pay for a chicken. In Russia they will take almost anybody's money in preference to their own. But fortunately these leaders and their followers in Canada are not very numerous, and the great majority of our people are long-headed enough to know that until human nature has greatly changed for the better, and a lot of people who now dislike work have learned to look upon it as a blessing to the race rather than a curse, they will prefer individualism, with its rewards for personal effort and industry, to being bound up with the slothful, the indifferent and the lazy in a system that would certainly make for lower production and higher cost of living. Labor should undoubtedly have a greater share of the profits of business than it enjoyed before the war, and this I am sure will be accorded by all sane employers of labor on a basis that will be equitable to all, the consumer included.

I want to state, after spending five weeks travelling in our Western provinces, 1200 miles by automobile, noting the abundant crops and the wonderful improvement in farms and buildings that has taken place in recent years, and marking the permanency of it all, coupled with the high courage of the men and women who inhabit these western cities and plains, thousands of whom are returned soldiers making good upon the land, as I learned from the supervisors and others who had the work in hand, that I come back with a larger faith than ever in the future of my native land and yours.

Let us continue to preach and practice the gospel of hard work, and the joy of it all, and be patient for a little when I am satisfied that every architect and useful workman of every profession and trade in Canada will find ample opportunity for the exercise of his talents and the pursuit of happiness.

## The Big Lesson Wrigley Learned in Dull Times

**"The result of my investigation was that I signed up in the midst of the depression of 1907 for $1,500,000 worth of advertising—our first national contract and a very large one indeed for us at that time. It was, as you see, another restraint in the face of an opportunity for immediate profit.**

**"But for once the policy did not involve the sacrifice of immediate profits even. We really had expected it would. We were after the vivid impression we thought we could make on dealers and consumers at a time when so few people were trying to sell them, and we were willing to pay something for that. We were willing to wait for our returns. But we did not have to wait. They came generously enough even the first month to meet what had seemed an enormous first payment on the advertising, due at the end of the month, and the payments every month thereafter were entirely met out of the increase in our profits, with a continually widening margin to spare."—Wm. Wrigley, Jr., in "System."**

# Improving Frame House Construction

## Suggestions for the Better Use of Wood in the Building of Dwellings —Development of More Adequate Residential Building Codes—Possibilities for Lower Costs

By DUDLEY F. HOLTMAN, Construction Engineer, National Lumber Manufacturers Association, before Indiana Real Estate Convention, October 12.

For six thousand years the human race has experimented with house construction. During this period almost every possible form of dwelling has been tried. The frame dwelling has not only survived the test of this time but it has grown and developed until to-day we have some of the most impressive evidence in every city of the land of the architectural and the artistic possibilities of wood in construction.

Wood is the most easily applied building material known but it is this very quality that has resulted in its careless use. A few boards, a nail or two, and you have a dog house—change the method of putting the parts together and you have a table.

It is said that when Galusha Grow entered Congress he carried a letter of introduction to Thomas Benton, then just concluding his thirty years of distinguished service. Naturally Senator Benton was pleased with the brilliant Pennsylvanian for he said to him: "Young man, you have come too late—all the great problems have been solved."

There are many Thomas Bentons to-day. They think that because the frame dwelling has come to us down the ages all the problems connected with its construction and development have been solved. Ah! But they have not. Dwelling construction is still in the experimental stage. If we are to continue a great home building nation, we must spend some time in the study of house construction—seemingly the most simple yet perhaps the most important subject before the people to-day—about the only subject which vitally affects all and yet to which few give serious thought. Our daily tasks together with current news—much of it frivolous and little of it thought inspiring—engage our attention. But the proper use of our most universally used building material as distinguished from cheap, skimped construction, is accorded scant consideration.

### Revised Building Codes

The importance of proper building code legislation cannot be over-emphasized. The United States Department of Commerce, through the vision of Mr. Hoover, has sensed the important place that municipal building codes occupy to-day. Mr. Hoover with the rare foresight that is his, has appointed a building code committee with seven distinguished authorities on building construction as a part of the current Department of Commerce activities in Washington. This building code committee during the last week in September held its second meeting in the city of Washington and at this meeting, what did it consider? Do you suppose that these men spent their time in thinking of factory construction, or hotel construction, or tenement house construction? No! They talked about the one type of construction which is more important to the people at this time than any other single type or combination of types of construction. They talked about the dwelling, the ordinary common house that must be built speedily if we are to take care of the ever increasing requirements of our citizenship.

Experience during recent years indicates that building codes, in order to be most beneficial, must undergo frequent amendment and addition. Methods and materials of construction and the uses to which buildings are put are constantly changing. New economic conditions bring about new kinds of buildings and in any case, there are a great number of minor contingencies for which it is impossible to provide in an ordinance. It has been found desirable, therefore, that the official in charge of building regulation be given the power to formulate and publish rulings elaborating upon the building code, as enacted by the legislative body of a city. A building code is intended to be a statement of the minimum requirements as to the quality of materials, grade of workmanship and methods of design which are considered necessary to make buildings safe, durable and otherwise satisfactory.

A building code should not be too definite and detailed in its provisions lest it lose a part of its possibilities for good and unduly hamper private initiative and enterprise. In effect, therefore, such an ordinance usually is a compromise between the necessity of telling the public what is required of it and that of making it brief and flexible for purposes of administration. Any building code represents the compromise at which its writers arrive with regard to these two questions.

### Building Codes Should Not be Too Restrictive

There is nothing that so handicaps the builder in his continual effort to keep construction costs reasonable as legislation framed and administered to require expensive or troublesome construction, or prevents the development and use of new and economical or rapid forms of construction. All restriction of the freedom and choice of the builder or owner, without logical necessity to preserve the public safety and dependability of construction, has a cumulative effect upon the cost of construction and acts as a very real deterrent upon the activities of the investor. No building law should bar any safe and dependable form of construction.

The whole object of the inquiry into building code matters at this time by the Hoover committee is for the purpose of reducing present costs of construction. It seems very probable that recommendations will come from this committee which will tend to very materially decrease the cost of building frame houses. As an example of one way in which a reduction in costs can be effected, let us consider the floor framing of such a house. The size of the joists which frame into the side walls and support the floors is determined not by the load which they can carry, but most usually by the deflection. In designing joisted floor construction, consideration is given to the deflection which will cause the plaster to fail and the joists are designed so that they will not deflect beyond this established limit. Since deflection and not strength, in most cases, determines the size and spacing of floor joists, it has been suggested that the joists be spaced further apart than they usually are in prevailing practice, and that a lower working-stress be used in their design. Such procedure would mean that joists which contain double the defects of those usually permitted at the present time be used with resulting lessening in the cost of the material going into the floor joists.

### Making the Frame House a Better House

Lumber manufacturers are just as anxious as any other group of citizens in this country to contribute to any measure which might have a tendency to accelerate the happy period when building homes will again be the order of the day. This is merely an illustration of the possibilities for descreasing the original cost of the frame dwelling. The possibilities for cutting the expense do not stop there, however, for the construction of a frame dwelling can also be improved and improved greatly. Improvements can be made in a frame house, in other words, that will relieve the home-owner of the necessity of spending considerable sums of money on replacement charges every few years. And by making the frame house a better house than it has been in the past we feel that we are contributing greatly to the popularity of this type of construction.

### Minimizing the Fire Risk

Fire stopping is of primary importance. It means the interposing of short pieces of wood within spaces that ordinarily serve as flues for the rapid spread of combustion. Most of the other improvements are protective in their nature and prevent wooden parts catching fire from chimneys, fireplaces, heating plants, steam and hot water pipes, etc. While, of course, wood will burn, it is also true that there is no such thing as a "fireproof" house within the reach of the ordinary pocketbook. What is now offered is an economical type of construction that is fire resistive and as nearly fireproof as frame construction as now developed can be made. It conforms strictly to the scientific building codes of the most progressive cities and carries a minimum of fire risk to the occupants because of the necessarily slow spread of combustion in such a building.

You are, no doubt, interested in building homes which are not only as inexpensive as possible, but which with economy combine all of the artistic qualities of a home especially designed by a competent architect. Lack of money, lack of ability to obtain what one might desire through a necessary stringency of funds, or whatever may serve as means of barter, make it impossible in the small home to have unrestricted, if any, individuality in the buying of materials, or the choosing of special forms or materials for the home. This situation is beginning to be amended by the co-operative service of a number of practising architects, who, in addition to their regular practise, are able to supply professional service and counsel, are able to furnish clients with well studied, carefully prepared plans, specifications, working drawings, quantity survey and complete details for the erection of homes up to and including, say, six primary rooms. When it comes to building homes the quickest, surest way to save money is to build from a quality, waste-saving plan. Don't take chances on incomplete and hit-or-miss drawings. Build from a plan so complete that you know the size, shape and quantity of every item that goes into the home.

# Sound Basis for Municipal Water Rates

## Paper Presented Before the American Water Works Association Makes an Analysis of the Factors Involved in the Marketing of Water, with a View to Determining a Scientifically Computed Service Charge

By E. E. BANKSON, D. E. DAVIS and C. A. FINLEY

The operation of a municipally owned plant affords the opportunity for rate making on the basis of true equity and free from temptations to adopt policies of financial expediency appealing to privately owned plants. There are many elements in common to both plants creating influences in rate making which are often reflected in widely varying results, due to the radical differences in policy adopted by the directors of a private corporation in the one and the legislators of a municipality in the other case.

The opportunity for variations between municipal rates results from differences in the so-called ownership of a municipal plant. The latter depends on the proportion of the investment contributed by property through tax assessments as contrasted with excess earnings gathered from water revenue and invested in plants. The reader will here understand that the expression "so-called ownership,, is used as a convenient term to indicate the source of money that built the plant. Unless this factor is recognized in the building of the rate schedule, some discrimination may result toward one or the other of the contributors to the plant cost, i.e., the property owner on the one side or the water consumer as such on the other side. The equity of rates imposed by a municipal plant would seem to depend, therefore, on this seat of so-called ownership.

A municipality may operate its water plant at a profit as a separate source of municipal revenue if it is disposed to do so and the law does not prevent. Such operation may favor the property owner who does not take water in proportion to the value of his property, such as owners of vacant property or of extremely valuable property requiring a small quantity of water. On the other hand, if the plant be operated at a loss with the deficiency repaired from the general tax levy, the water taker or consumer as such would then be favored at the expense of the tax-payer.

The thought often exists in the mind of the layman that substantial justice will be done if all revenue is derived from water sales, since the consumer and the property owner are substantially one and the same. That this is not strictly true is evident when we consider such extreme cases as the valuable vacant property or the large office building, which enjoys water service, fire protection, and increased property value out of all proportion to the relatively small charges for water used, on one hand, and the very large consumer of water, on the other, whose business is housed within a relatively inexpensive building or property.

The decision to operate a municipal plant at a profit, or at a loss, however, is to be determined in part by administrative policy, rather than as entirely a question of scientific rate making. If accurate cost analysis is to play any part in the problem of rate making, however, it must precede and remain separate from questions of administrative policy, except that the term "cost of service" may be subject to different interpretations according to the administrative policy obtaining. The results of cost analysis are to be used for the purpose of moulding or indicating the correct administrative policy in this respect. The major purpose of this discussion being "Total Cost of Service," resulting in the "Rate Base" or "Total Annual Burden" and the equitable distribution of this burden among the various consumers of a municipally owned water plant, we intend that any mention of administrative policy in connection with cost be considered only as contributory discussion.

### Cost of Service

Cost of water service as deduced from the practice of public utility commissions in their control of privately plants, is made up as follows: (a) Fair return on a fair plant value, (b) an allowance for plant depreciation, (c) cost of plant operation and maintenance, wherein the item for "fair return" incorporates any profit permitted for the utility. The three items indicated are based on used and useful plant value.

This discussion of absolute cost of service rendered by a municipal water plant will not incorporate an item of profit, and consequently the item of "fair return" for private plant will be replaced by an item which may be designated as "interest on capital invested." Where the so-called ownership of plant, bonded indebtedness, sinking fund, and interest rate paid may vary with each plant, it follows that the total cost of service will vary with each municipal plant, though the terms "depreciation and operation" carry the same meaning as indicated above. This "cost of service" as distributed to consumers through the medium of the rates charged will be further dealt with under the heading "Distribution of the Burden."

*Water plant statistics for 1919-1920*

| CITY | POPULATION | PLANT VALUE | BONDS OUTSTANDING | PLANT VALUATION PER CAPITA | OPERATING COSTS | OPERATING COSTS PER CAPITA | NUMBER CONSUMERS | OPERATING COST PER CONSUMER | MILLION GALLONS DAILY | OPERATING COST PER MILLION GALLONS |
|---|---|---|---|---|---|---|---|---|---|---|
| Cleveland | [illegible] | $28,000,000 | 12,000,000 | $28 39 | $953,936 | $0 97 | 106,702 | $8 75 | 127 | $20 50 |
| Toledo | 260,000 | 12,500,000 | 1,915,000 | 48 00 | 382,335 | 1 47 | 45,500 | 8 40 | [illegible] | 37.30 |
| Buffalo | 510,000 | 19,198,490 | 12,847,492 | 37 60 | 890,948 | 1 74 | 76,258 | 11 70 | 136 | 18 00 |
| Akron | 160,000 | 10,000,000 | 9,000,000 | 62 50 | 267,000 | 1 67 | 32,000 | [illegible] | 20 | 36 50 |
| Milwaukee | 500,000 | 10,000,000 | 195,000 | 20 00 | 458,973 | 92 | 66,422 | 6 92 | 61 9 | 20 40 |
| St Paul | 250,000 | 7,443,707 | 2,407,000 | 29 75 | 247,722 | 99 | 46,000 | [illegible] | 17 6 | 38 60 |
| Youngstown | 132,000 | 2,610,887 | 763,200 | 19 75 | 276,294 | 2 09 | 21,169 | 13 00 | [illegible] | 63 00 |
| Toronto | 499,276 | 16,000,000 | 16,209,316 | 32 00 | 1,150,599 | 2 30 | 104,766 | 11 00 | [illegible] | 42 00 |
| Syracuse | 171,000 | 15,000,000 | 4,105,000 | 88 00 | 249,395 | 1 45 | 25,450 | 10 00 | 27 5 | 25 00 |
| Detroit | 1,108,735 | 23,583,428 | 2,855,114 | 21 20 | 1,159,333 | 1 05 | 164,779 | 7 40 | 152 | 21 00 |
| Sandusky | 30,000 | | | | 60,615 | 2 00 | 5,600 | 10 80 | [illegible] | 41 50 |
| Indianapolis | 267,000 | 10,000,000 | *Private* | 37 50 | | | 46,060 | | 29 | |
| Albany | 112,568 | 3,099,000 | 1,520,850 | 27 50 | 360,100 | 3 22 | 20,674 | 17.40 | 20 | 49 30 |
| Rochester | 295,850 | 13,800,000 | 10,445,000 | 46 70 | 867,000 | [illegible] | 49,484 | [illegible] | 25 | 95 00 |
| Canton | 90,000 | 3,000,000 | 1,500,000 | 33 30 | | | 22,000 | | [illegible] | |
| Pittsburgh | 547,000 | 32,000,000 | 10,698,392 | 58 50 | 1,422,762 | 2 00 | 91,617 | 15 50 | 118 4 | 32 83 |
| Duluth | 98,000 | *3,650,776 | 2,424,000 | 37 20 | 98,587 | 1.20 | 13,401 | 7.35 | 9 | 37 20 |
| Harrisburg | 76,917 | | | | | | | | 9 1 | |
| Totals | 6,098,348 | 209,886,288 | 88,885,364 | | 8,845,599 | | 939,902 | | 884 5 | |
| Average (to here) | | | | [illegible] | | 1 88 | | 10 10 | | 38 07 |
| Erie | 110,000 | 3,755,000 | | 34 10 | 263,589 | 2 30 | 19,000 | 13 35 | 20.4 | 34 80 |
| Minneapolis | 300,000 | 11,000,000 | 1,750,000 | 33 30 | | | 61,000 | | 27 5 | |
| Williamsport | 45,000 | 1,600,000 | *Private* | 35 50 | 77,141 | 1 71 | 11,000 | 7.00 | 8.5 | 24 86 |

### Ownership of Plant

There is no contention that the city does not own the plant, but there does appear to be a difference in equitable rates, dependent on the source of funds for plant purchase. The two sources are the general tax levy and the charges for water service, as illustrated in the following comparison.

The water works plant of the city of Toronto, Canada, appears to be bonded to more than its present value, and Akron, Ohio, only slightly less, as indicated in the tabulation of "Plant Statistics." This means, in a sense, that the bond holders own the plant and the cost of service must incorporate the total interest on the bonded debt. Unless, in addition, the water revenue provides also a sinking fund for retirement of bonds, the water takers as such will never hold any equity in plant account. If the operating revenue, in this case ,should provide a sinking fund, in addition to interest and operating cost, the rates would ordinarily need to be as high or higher than those permitted for a private plant.

The water works plant of the city of Erie, for purposes of this discussion, may be considered free of debt. Since there are no interest or sinking fund charges to meet, one might easily and erroneously conclude that the water rates in Erle should be much less than in Toronto. Such is not necessarily the case, for the water rates in Erie provide the only source of revenue for plant extension and replacements. In other words, the water takers in Erie are paying for their plant as they go along, and for the past ten years this cost has been approximately equal to 6 per cent on the plant cost. This item therefore takes the place of interest and sinking fund for a bonded plant in the "cost of service" for Erie. If Erie should ever stop growing, however, and no further plant extensions should be necessary, this item would disappear from the "cost of service" and the water rates should decrease accordingly, whereupon the advantage of this position would be more apparent. From the above discussion, it is evident that the water takers have provided the funds for investment cost of the Erie plant and in the spirit of this discussion we might say that the water takers or consumers own the Erie plant.

The water revenue in many other cases is insufficient to carry the annual burden and any bonds retired would indicate a credit to the general tax levy, which should entitle the tax levy to the regular city interest rate on all plant investment actually made. In setting up the "cost of service," the general tax levy should receive a ledger credit for providing these funds, resulting in a corresponding charge to the water takers, which would appear in the "cost of service" distributed among the individual water accounts through the rates applied, with public service and fire protection carrying a proper portion of the cost.

We understand that the present policy in the city of Cleveland provides that the ownership of small distributing street mains and service lines to the curb is vested in the property owner. At any rate he foots the bill and carries that entire burden by direct assessment as for sewers or for street paving. In the city of Erie, however, the total burden is carried by the Water Department, thereby creating a difference in the basis for equitable rates in the two cases. In the one case, the consumer has gone down in his pocket and paid outright for his service line and street main, or, if he is a renter, he meets that burden through his house rent, while in the other case the burden of said items appear in the water rates, corresponding to a return on investment. This variation results from the different location or seat of plant ownership of the items in question.

The city of Pittsburgh offers a third comparison in this connection. There the property owner assumes the burden of the service line and the water department that of the service mains. A difference as to ownership of meters offers yet another comparison. The purpose of presenting the foregoing examples is to lend support to the statement that the rates charged for water in one city offer no evidence of equitable rates to be charged in another city or in a private plant. Each case must be analyzed separately and must stand on its own merits under the full conditions obtaining in each instance.

In support of the thought that each schedule of rates stands alone, we tabulate data from replies to questionnaires sent to several cities. This tabulation indicates, among other things, that the bonded debt and resulting fixed charges vary from 0 per cent to 100 per cent, that the plant value varies from $19.75 to $88.00 per capita and that the operating cost ranges from $0.92 to $3.22 per capita or from $18.00 to $95.00 per million gallons.

Another deduction from this table, which may be of interest to some, is that an average plant value is slightly less than $40.00 per capita, while the average operating cost for 1919 was slightly less than $40.00 per million gallons, although this figure would be reduced in normal times.

### Service Rendered

The functions of a water works plant are admittedly two-fold, that of furnishing a water supply for general consumption and for fire protection. Since this discussion is based on the principle that "the rates charged for any service should be in proportion to the cost of such service," it becomes necessary to make a careful analysis of all functions and duties assumed by the water department and of all service rendered

Fire protection service is rendered to property or to property owners in proportion to the value of the property protected. Charges for such service, therefore, should be entered directly against the property. or against the general tax levy. General water service is rendered to persons or industries largely in proportion to the water delivery, with no necessary relation between value of property and quantity of water delivered. To make a proper accounting for all service rendered, the charge for water cannot properly cover fire protection, for there is no necessary relation between the two, and in fairness to all concerned, a charge for fire protection must appear separate in a complete schedule for equitable rates.

The provision of a water supply for fire protection service creates an increase in plant investment and in plant operation over and above the costs which would be sufficient for general water service. The exact cost of fire protection service has been somewhat in doubt within the limits of the two methods of computation used, that is, the excess method and the proportional method. After a careful analysis has been made of fire protection service rendered by any plant, a cost for this service, however, can with fairness be established and a charge indicated in that amount. In the case of the City of Pittsburgh the ratios chargeable to each service were obtained from available records of actual demands.

General water service may first be separated into two groups as public service and private service. If the tax levy carries the burden of plant investment this may amount to more than the cost of the public service received by the city and by property in general. In such a case the ledger should show a credit to that extent, in this way offsetting the charge for public service. General water service is again divided according to flat rate service and metered or measured

### Flat Rate Service

The flat rate method of charging for water service, a heritage to us from pioneers in the water works field, carries the approval of the wasteful user, because it permits his extravagance at public expense. It does not seem to disappear rapidly through a process of the survival of the fittest. It would seem, therefore, to devolve wholly on the water works men to gradually make obsolete the flat rate system. Flat rate charges or assessments are admittedly inequitable and conducive to wasteful habits. But being yet with us, they should always appear in excess of meter rate charges, for the same amount of service, with the hope that such a practice will create converts to the metered or measured service method, although experience shows the latter to be not always the case.

The average domestic flat rate in the city of Pittsburgh is 55 per cent in excess of the meter rate for similar service, but every flat rate consumer has the option of transferring to measured service if he desires. Even with this high flat rate there remains under flat rate service approximately two-thirds of the total number of consumers with no apparent desire to avail themselves of the economy offered. In fact most of the metering accomplished has been of a compulsory nature.

The Pittsburgh plant has a capacity in excess of fully metered requirements. It is interesting to discover through cost analysis that no economy may be effected by metering the entire city at once; or at any rate in excess of that necessary to reclaim plant capacity from wasteful service to useful service, or additional demands, as conditions may require. In the case of Erie, however, the plant capacity has been reached under the present flat rate policy, and it is clearly evident, in the interests of economy, that a policy of metering domestic consumers should be adopted.

.. ... ...

Metering may reduce domestic consumption by more than half, which has the same effect as increasing plant capacity. It is far cheaper to meter than to build additional plants. It would be poor economy (in fact wasteful) to create additional plant capacity for the purpose of supplying flat rate consumers, instead of placing them under measured service. Aside from discussion along lines similar to the above, we cannot see that flat rates have any place in scientific rate making, for flat rates are subject to the laws of neither science nor equity.

### Measured Service

In the case of the city of Pittsburgh, the computed demand under fully metered conditions would show a reduction of 40 per cent from the present pumpage.

Such a reduction represents no curtailment of useful service, but it represents rather the reducible leakage and careless running of water to waste, which simply flows down the sewer and does service to no one.

There appears a common error among water works service. men and engineers of overestimating the amount of water which will be used when a city is fully metered, with the result that a financial deficit appears as metering progresses. This tendency to overestimate is a logical result of a habit formed in designing plant capacity for maximum conditions. Such a designer carries this habit over into the field of rate making, where he discovers, too late, that his measuring stick was too large and the revenue is not realized as computed.

We have also observed a tendency, on the part of the inexperienced, to use the present pumpage of a flat rate system, as the starting point to forecast future revenue under fully measured service. They apparently forget that there is no reliable relation between the two and that revenue is indicated by the dial on the consumer meter rather than by the pump counter.

.. ...

(To be continued)

# Wide Field of Service for the Engineering Institute

## Mr. Geo. T. Clark, Chairman of the Toronto Branch of the E. I. C., in his Inaugural Address on October 13, Sets High Standard for This Year's Activities

The possibilities for real accomplishment by the Toronto branch during the coming winter are, it seems to me, greater than they have ever been in the history of the branch. It is true perhaps that the activities of the branch are limited to a certain extent by the general policies adopted by the headquarters of the institute, yet the individual branches to-day are given a good deal of latitude and are allowed, and rightly so, to largely manage their own affairs and work out their own problems.

Mr. Geo. T. Clark, chairman of the Toronto branch, E. I. C.

The scope of the institute has broadened out materially since its name was changed from "The Canadian Society of Civil Engineers." There was a time when the meaning of the word civil engineer was so broad as to embrace every possible line of engineering work, and was used to distinguish from military engineering. During that time the Canadian Society of Civil Engineers could have been justly considered as truly representative of all its members no matter in what special branch of engineering they were engaged. There was also a time when the mere interchange of technical knowledge among the members of a technical society was of sufficient interest to sustain such an organization in an active condition. But times have changed. The engineering profession has broadened out to an enormous extent; numerous new branches and activities in the profession have been created. Civil engineering itself has become narrowed down to mean and include only certain, definite and limited lines of engineering undertakings. Other lines of engineering, equally as important, have become developed and justly demanded independent recognition and designations as major branches of engineering, such as mechanical, electrical, mining and chemical. It was no longer possible to include all members of the profession under the title of civil engineering, and it becomes imperative to change the name of the society so as to make it unmistakably representative of the entire profession. It was thus that the name of the Engineering Institute of Canada came into being.

Likewise the activities of the Canadian Society of Civil Engineers, which were limited chiefly to interchange of technical knowledge among its members, were beginning to lose their attraction in the eyes of the new members, particularly the younger men. With the limited and narrow activities it was no longer possible to create sufficient enthusiasm to warrant the growth and expansion which such an organization requires in order to live. Changed conditions brought about by economic developments in recent years made it quite evident that above all the engineer is human, and in addition to the technical problems that he meets with in his daily work he also has other problems, in common with the members of all other professions and classes in the community, which should receive his earnest attention. It became apparent that if the Canadian Society of Civil Engineers was destined to become the leading organization of the engineering profession in Canada it must assist its members in the solution of their human problems as well as their technical problems even if to do so it might have to abandon some of its old traditions and recognized policies.

It is generally recognized, I believe, that the reorganization of the Canadian Society of Civil Engineers into the Engineering Institute of Canada paved the way for broader activities in new spheres which will ultimately result in greater usefulness of the institute to the individual members, and of the members of the institute to the general public. Our organization as founded and in existence to-day is, it seems to me, bound to be successful, because its constitution is flexible enough to be capable of adjustment to the constantly changing conditions and requirements of its members.

To justify its existence then the institute and all its activities must be dominated by the desire and the determination, backed up by the individual effort of every member, to be of service, first to its own members, and secondly to the general public.

In what way can the Toronto branch be of service to its members.

1. By facilitating the acquirement and interchange of professional and general knowledge among its members.

I have always been of the opinion that if we would substitute papers of general knowledge for some of the most technical type, our weekly meetings would be more acceptable to the majority of the members. Having that idea in mind the subjects chosen for this year's programme include public health, finance, park treatment, contract law, city planning, transportation, as well as technical papers covering all branches of engineering mork.

2. By promoting the professional interests of the members.
   (a) By securing proper recognition for the profession.

As a result of concerted effort, engineers have already succeeded in obtaining special legislation in all but three provinces of the Dominion. This special legislation is primarily intended to serve one main purpose, namely, to protect both the public and the profession from the results of the practice of engineering by those not qualified. If this principle is rigidly applied to any engineering legislation that may be framed it will be found that the engineer has received his full measure of protection. All that engineers as a class are entitled to is some effective means of protecting their professional reputation and prestige. Legislation has been framed to meet this end and so framed as to be for, and not at the expense of, the public weal. Anything beyond this may be defined as class legislation, which in the final analysis does not protect, but stigmatizes, and would ultimately force the engineer into the position of having to protect his legislation instead of having his legislation protect him.

In the province of Ontario last session the Advisory Conference Committee, the Ontario Provincial Division and the various branches expended a great deal of time and effort on an Engineers' Bill for this province. Unfortunately it was submitted to the government too late to be considered by the Private Bills Committee and had to be referred to a special committee, which did not report before the close of the session. There did not seem to be any particular opposition to the bill itself, and I believe we are justified in believing that we will attain our objective during this session of the Legislature, provided every member of the institute in this province uses every means in his power to further the interests of the bill.

(b) By securing proper remuneration for engineering service.

A great deal has been said and written on this important topic during the past two years, and perhaps no single subject has received as much attention and consideration from the various bratches as the question of classification of and compensation for engineers. The Toronto branch was the first, I believe, to submit a report on this matter. The report of the special committee was approved by the branch and submitted to headquarters, and since that time a number of other branches have forwarded similar reports. Headquarters then decided, through their committee on policy, that it was a matter which they should take up. As a result of this action a committee on remuneration was appointed by the council to study the whole question, using as a base the reports of the various branches and having access to the schedule prepared by the Engineering Council of New York. Their findings have not yet been made public.

There is no doubt but that the problem of adequate remuneration is a difficult and complex one. The subject is closely allied with the whole question of economics, which in turn is an important phase of the problem of production. The production of the engineer is evident in constructing means of transportation whether by rail or water, in the development of an irrigation project, in the inventing and perfecting of machinery, in the generation and transmission of electrical energy, in obtaining from the earth its store of mineral wealth, or in the chemical analysis of the metals and kindred building products. In every one of these processes, the main objective is to obtain an adequate return on the money invested, and the engineer is depended upon to produce the desired result, and every detail in his daily work is thought out from the standpoint of economics. Probably a foreman with no technical training could design a steel bridge that would carry a train. The qualified engineer gets the same results, but uses ten or twenty per cent. less metal. The saving is not only to his principals, but to the nation in the conservation of natural resources. This priniciple of economics enters into the daily life of the engineer more than into that of any other profession, and assuming the above statements to be correct, who is better qualified to deal with the big economic problems than the engineer?

At the present time the entire world is undergoing a period of economic readjustment, which has thrown everything out of balance. Uncertainty as to what the future may bring is affecting business relations. The wheels of industry are certainly not running smoothly, and not only individuals, but whole nations are suffering as the result of adverse trade conditions. In such a chaotic condition of affairs one naturally asks the question what service could engineers render to ameliorate these conditions, to assist in speeding up the readjustment and to clear away some of the clouds of uncertainty that are dimming our vision. How tremendously worth while it would be if the engineering profession would grapple with and assist in solving this acute problem, and having done so who would deny us a remuneration comparable with the service rendered? Let us place a higher estimate on our own value to the community, not only in our professional relations, but in all matters of community interest, and employers of engineers, as well as the public, will be quick to accept us at our own valuation.

3. By maintaining high standards in the profession.

The committee on ethics, under the chairmanship of Mr. Mylrea, presented two reports to the branch last year on a code of ethics for engineers. The committee will report further in the near future. Other engineering organizations are also attempting to write new codes of ethics. These efforts are, it would seem, a hopeful sign of progress, not necessarily because it will produce a good code of ethics, but because it will increase the thought which engineers will devote to the ethics of their relations to fellow-engineers and to the public.

It is inevitable that each one of these engineers, by virtue of such reflection, will become more keenly conscious of the special public trust with which he is charged by reason of his profession's place in community existence. Therefore, even without the production of an accepted code, co-operative study of the subject will yield benefits to the public as well as to the profession by quickening the professional conscience and recognition of the duty of service.

In addition to this, it is broadly true that any movement which aims to re-formulate basic principles of just conduct is of very special value at the present time, since the engineers' objective attitude is most essential to the world's reconstruction.

There is another thought that occurs to me in connection with this question of ethics, particularly in regard to our relation to the public. Why do engineers frequently harbor personal feelings against those with whom they disagree on technical matters? Engineers are perhaps more sensitive regarding disagreements of opinion than other classes, because they are accustomed to dealing with facts and with immutable natural laws. He feels instinctively that there is about everything a definite position which must be right; what differs from it is wrong. There is, of course, a right and wrong to every question, but the difficulty is that most problems are so complex that we are unable, with absolute correctness, to appraise the value of each factor. Some problems are subject to exact mathematical determination, but by far the greater number of them call for the application of the standards of individual experience; in other words, of judgment.

We need, therefore, to realize that our opponent in the discussion may have as good ground as we for his conclusions, and to derive from that reflection an attitude of tolerance, and respect, for opposing views. Above all, we need to regard problems as objective and to refrain, unless the grounds are very clear, from imputing motives to our opponents. Let there be fair, even strenuous discussion, but let the personal relations be in nowise disturbed.

4. By giving due publicity to the work of the profession. The ordinary means of obtaining publicity for the engineering profession are fully numerous. The outstanding requirement under this head is for engineers as a class to participate in the affairs of federal and provincial government. This contention is so fundamentally sound and so generally recognized that it is not necessary to enlarge upon it. It is true beyond argument that the recognition of the engineer as related to national affairs cannot be advanced or conserved unless the engineers themselves exercise active governmental functions in connection with the laws relating to, or incidentally affecting, the profession.

Among other channels of publicity may be mentioned the active participation of engineers in all general problems affecting the life of the community, and in developing such problems into specific schemes for government ratification and administration. Conditions governing publicity in the broad sense demand that engineers identify themselves with all beneficent movements and projects, particularly those which have a wide public appeal.

During the annual convention of the Engineering Institute of Canada in Toronto last February, the engineering profession received more newspaper publicity in three days than it had during any previous similar period in its existence. Recognizing, as they must, the work of the engineer in the community, there is no reason why the daily press should not give our weekly meetings a proportionate amount of publicity. This, however, is one point in which we conflict with the policy of the institute headquarters, as the Journal will not publish any paper, a synopsis of which has been given to the daily press. It is a question on which there is room for honest difference of opinion. My own view is that more benefit will accrue to the profession by the publicity we receive in the daily press than by the publication of these papers in the Journal, where none but the engineer will ever see them. However, I am satisfied to leave the matter in the hands of the publicity committee under the chairmanship of Professor C. R. Young, to do whatever they think best.

There is another question which should, I believe, receive the attention of this committee. Very frequently in the newspapers, innuendo and quoted surmises, by those unqualified to make them, causes a distrust in regard to the works of the engineer which is entirely unwarranted. A published statement of the facts of the case by this committee would go a long way towards retaining the confidence of the public in the work of the profession.

### Finance

For the first time in the history of the branch we have considered it advisable to appoint a finance committee, of which Col. Lamb is chairman. This committee will examine and O.K. all bills for payment. They will be responsible for the collection of back dues. They will also have the opportunity of making an effort to increase our revenue through increased advertising in the Journal.

The question was also raised at the annual meeting last winter as to the advisability or otherwise of increasing the annual dues. This question might well receive the attention of the finance committee, and I would suggest that they report to the branch on the matter some time before the annual meeting in Winnipeg.

It will interest the members to know that the annual convention committee, under the chairmanship of Col. Lamb, has handed to the branch the amount of the surplus from the last annual meeting, a total of $360.00.

### Membership and Reception

Your executive has deemed it advisable to combine the membership and reception committees in one. The duties assigned to it are to see that those who attend the weekly meetings become personally acquainted and that the membership in the branch be increased in all its classes. Mr. Wynne-Roberts, chairman of this committee, was very active along both these lines last season, and we can be confident, I am sure, of splendid results.

Some dissatisfaction has been expressed from time to time in regard to the present classification of membership in the institute. This committee might very well consider this matter and prepare a suggestion to be submitted at the annual meeting.

### Zoning

Zoning is a subject which has attained much popularity in recent years among engineers, architects and indeed among all classes who have an interest in the general welfare of their home community. You have no doubt noticed that Mr. Seymour, who is chairman of this committee of our branch, is editing regularly a special column in the Institute Journal dealing with this question. It is very desirable that this committee should continue its work, and we are anticipating during the session an interesting discussion on this subject, as well as one by Mr. Crossley's committee on social service.

### Unemployment

During the winter of 1920-21 there was considerable unemployment among engineers, and a committee was appointed, of which Mr. Jack was chairman, with the object of keeping in close touch with employers of engineering services in the hope that some service might be rendered to those out of employment. We are all fully aware that, from present indications, conditions will be even worse than last year. I am free to confess that personally I am unable to suggest any practical solution to this tremendous problem. Through our committee every effort will be made to place our members where there are vacancies, but without being too pessimistic, I am afraid those vacancies are going to be very scarce. Whether the etsablishment of a fund administered to provide temporary financial aid to those in need is practical or not remains with the branch to say.

The by-laws, fees and library committees are all important integral parts of the organization which we have attempted to build up in the past, and which are still carrying on and as a result of whose work benefits will accrue directly or indirectly to every member of the branch.

Nor must we forget the social side of our responsibility. There is perhaps no better way of getting our membership personally interested in each other than by the holding of social functions. The suggestion has been made to have one large engineering function in which all branches of the profession might co-operate. If the idea meets with your approval, I would suggest that the branch be authorized to-night to invite a conference with other engineering bodies with this object in view.

In regard to the service which the members of the Engineering Institute of Canada can render to he general public, to their home community and to the nation, the problems which Canada has to face in the immediate future are problems in the solution of which the engineer must play an important part. The influx of foreign population, which will be great, is bound to create a situation to deal with which will require the utmost wisdom.

We as engineers should see to it that we are not in danger of repeating the discreditable slum conditions prevailing in the old world, conditions which are productive of disease and physical and moral deterioration. The engineering profession should be able to do more than any other to advise measures to deal with this problem. It means improved methods of economical house construction. It means good roads at moderate cost. It means a scientific planning of streets and parks, and it means a rapid transportation system with moderate fares to relieve the congested districts. The incoming immigrant must be Canadianized, and in what better way can this be accomplished than by showing him that the new conditions in which he will live in Canada are infinitely better than those he left behind. The trained intelligence of the engineer will always be a factor in the solving of this most difficult question.

The second way in which members of the institute can be of service to the nation is in regard to the present industrial situation. One of the important factors of present-day industrial stagnation is the high cost of construction, and yet there has been very little organized effort on the part of engineers to promote construction activity. There is a growing feeling, however, that engineers should become leaders in political economy and a strong conviction that the time is opportune for engineering organizations to take the leadership in persuading the public to support every truly economic plan for public works.

The assuming of such a leadership by engineers would be well-timed, because the recent war has taught the public much about the importance of engineering, and because the present business depression makes it generally evident that a revival of construction activity will assist in accelerating the wheels of industry.

In a recent article in the "Engineering and Contracting" it was pointed out that the construction industry is one of the five greatest industries in the country. Construction is divisable into three classes—private, public and semi-public. Approximately 30 per cent. of the whole is private and the remaining 70 per cent. is public or semi-public.

In order to stimulate construction activity there should therefore be concerted effort to convince the public that when times are hard public works should be started on a large scale. It is false to argue that when private companies are reducing expenditure for construction, governments and municipalities should do likewise. If engineering societies would take the lead they would find it easy to secure the co-operation of various public bodies and the daily papers in spreading propaganda favorable to a programme of extensive public works.

In a special bulletin recently issued by the United States Chamber of Commerce, the statement is made that one-fourth of their national wealth is represented by the structures and projects built by the construction industry. The current importance of the industry is indicated by the fact that one-fourth of the persons engaged in manufacure are working on material and products that the constructor will use, and it is for the engineer and architect to plan how this huge amount of material is to enter into the actual construction. The majority of engineers, I am afraid, do not fully appreciate their value to the community.

Herbert Hoover, addressing the American Engineering Council on taking up the slack in industry, referred to the thought and influence of their 200,000 professional engineers, and continued: "This great body of men in administrative and technical service penetrates every industrial avenue, and thus possesses a unique understanding of many of our intricate economic problems and an influence in their solution not equalled by any other part of the community. Wanting nothing from the public either individually or as a group they are indeed in a position to render disinterested service."

When Franklin K. Lane, the Canadian-born Secretary of the Interior in the late Wilson Administration, died, the New York Tribune had a news item in connection with his death which read: "He left no will and no estate." The following editorial comment of the Engineering and Mining Journal in connection with the above laconic sentence could, I believe, be truthfully said of the lives of a great many members of the engineering profession: "We know that he left an estate, a legacy beyond the ability of accountants to evaluate. He left the memory and the inspiration of a high soul and a clean life. of a great ideal of public service of a career devoted to humanity, which great things so occupied him that he never found time for the accumulation of wealth. We know that he left a will, a will to live intrepidly and without currying favor, and to die serenely awaiting the orders of a destiny which he frequently recognized was beyond his comprehension."

# Economics of Town Planning

## The Fundamental Ideas Involved—Problems of Railway Communication

By NOULAN CAUCHON, Chairman, Town Planning Commission of Ottawa, at Town Planning Conference held at Montreal.

Biologically, an organism is a living entity, simple cell or complex, endowed with energy of growth and function. Human organism—the most complex known—is the raison d'etre of town planning, of its being a biological necessity.

The rays of the sun are the ultimate source of all energy on this planet, and as shown in the spectrum vibrate heat and light and chemical action. Sunshine and vivified air are indispensable nourishment for human development—without substitute—wherein lies their virtue beyond mere accessories of mechanical light and ventilation.

Cities which are the sheltering hives of human organisms must afford suitable environment for organic growth and development; failing which they cramp, maim, and kill that life which it is their proper function to engender, energize and enhance, and bring to the realization of life.

Economics is the science of the conservation and the conversion of energy in the maintenance of life—of human life.

Government, in the abstract and in practice should be synthetic organization for the maintenance of life—of community life—of civilization. This view of Government manifests a claim upon it for securing, amongst other things, free access to sun rays and fresh air—energy—for us individually and collectively.

According to Hy. Fairfield Osborn, the "capture, storage, and release" of energy is seemingly the problem of life itself. Our planning, if it would avail and survive, needs meet the requirements of life. It must make provision for structure and its nourishment and for the development of function.

Only that planning will prevail which recognizes the manifest oneness of Nature.

Let us consider the great functional ramifications of communication in their relation to organic existence

The emergence of human speech and the advent of barter developed the written word and the highway—evolved the rapidity of modern thought transmission and of transportation—modern civilization. Railways are, therefore, but a subdivision of highway function, but so far differentiated as to require individual treatment.

Railways seem destined to maintain and to increase their utility for long and heavy haulage. This traffic will develop to the auxiliary measure of better highways and increased motor transport.

In the nature of things, railway facilities must adequately keep pace with the increase of population and production and their incidental services. Duplication is economic waste and while a measure of competition is valuable as a stimulus, if extended to the over-stimulation of duplication it will, by natural law, defeat its own purpose and is uneconomic and a waste of energy.

The principle to be applied as regards cities is **Union Terminals.** There is little question as to the wisdom of a single system of trackage minimizing movements, crossings, and vast unnecessary capital expenditure. But there are optional ways of operating the necessary plant—ways of efficiency.

Montreal, as our largest city in Canada, is suffering from the lack of proportion in its services.

The purpose of town planning is to avoid and to eliminate congestion—on the railways, on the highways, and in all the vital agencies of progressive existence.

Montreal's problem is emphasized by its railway and its highway requirements—it is conditioned by the necessary disposition of its centres of activity along the harbour front, and in turn is subject to the topographical limitations of the adjacent mountain. The city of Hamilton Ont., has a somewhat similar problem.

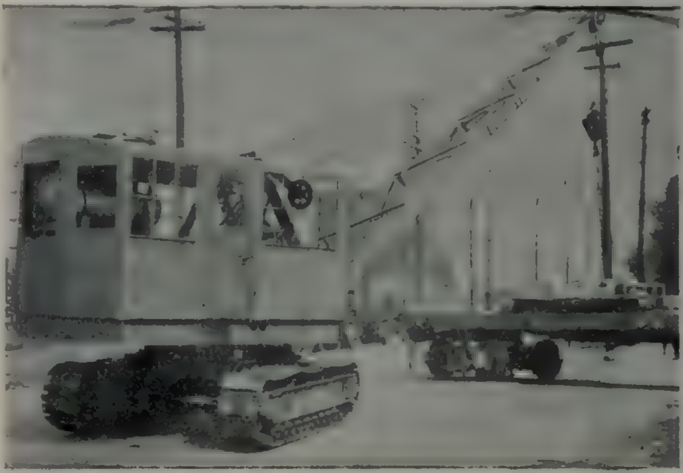
You have a housing problem the same as our smaller centres, only greater by reason of acceleration in size—it is all part of the oneness of your problem of existence which awaits progressive solution.

To quote from a previous address to a committee of the senate (May 25, 1921):— "It follows that determining the occupancy of land and of buildings, the width of streets and the height and bulk of structures in relation thereto, the access of light and of air, zoning, housing, the capacity of transportation, is elemental to healthy freedom of growth and of circulation; all, to the measure of their deficiency, shadow the birth rate and the death rate".

## New Type Crawling Tractor Crane

The type BC "Industrial" crawling tractor crane, illustrated in the accompanying photograph, manufactured by the Industrial Works, Bay City, Michigan, has been developed to meet the need for a full-revolving tractor crane which can be operated independently of rails. The crane is built in two types—the type BC with a capacity of 20,000 pounds at 12 ft. radius is equipped with four broad gauge tractor wheels.

These cranes are pre-eminently adapted to the needs of road contractors, coal dealers, gravel, sand and stone producers, foundries, and moderate-size manufacturing plants. Their capacity and speed make them ideally suited for doing such jobs as moving coal, sands, gravel, etc., and for excavating duty. Within the limits of their capacity they will serve with the same efficiency as the railroad crane. They can be equipped to handle a hook and block, grab bucket, drag scraper bucket, wood grapple, electric lifting magnet, shovel dipper and pile driver leads with drop hammer. Operation is by means of an internal combustion engine. The crane is equipped with thirty foot boom made up of two channels strongly latticed with angles and tie plates.



The steering of the crawling tractor crane while propelling is accurately controlled by the operator from his position in the revolving upper-works, by manipulation of the friction clutches and brakes controlling the motion of each tractor belt. By means of these clutches and brakes either tractor belt can be readily and instantly disconnected from the motor while the other belt continues travelling at the normal rate of speed. The disconnected tractor belt can be held stationary by applying the brake, can be allowed to coast with the brake and clutch both disengaged, or the clutch can be allowed to slip, thus allowing the operator to turn as sharp or as wide a corner as he may select. All the clutches, brakes and lever mechanism for steering is located in the revolving upperworks where it is simpler and much more accessible than when a portion or all of this mechanism is located on the car-body.

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It is likely the Border Cities Housing Commission at Windsor will shortly disband, as the housing situation is fairly well in hand now. The commission has constructed over 300 homes during the past two years.

# A Small House Suggestion

## Details of Two-Storey House at Victoria, B. C.

The two-storey house shown in the accompanying photograph and plans was built for Mr. A. C. McDonald, of Gordon Head, Victoria, B. C. by Messrs. Evans & Green, the architect being Mr. S. Maclure, both of Victoria. Built to replace a dwelling that had been burnt down the history of the house as at present designed is interesting. The original idea was to convert an unused barn on the property into a dwelling, and the architect was asked to prepare suitable plans for this purpose. This was duly done and tenders called for, but when these came to be considered it was found that the cost of the work would be so much greater than the owner anticipated that the idea was abandoned in favor of building an entirely new house. The owner however, was so pleased with the architect's design that he decided to have the new house built on the same lines.

Two-storey residence described in accompanying article.

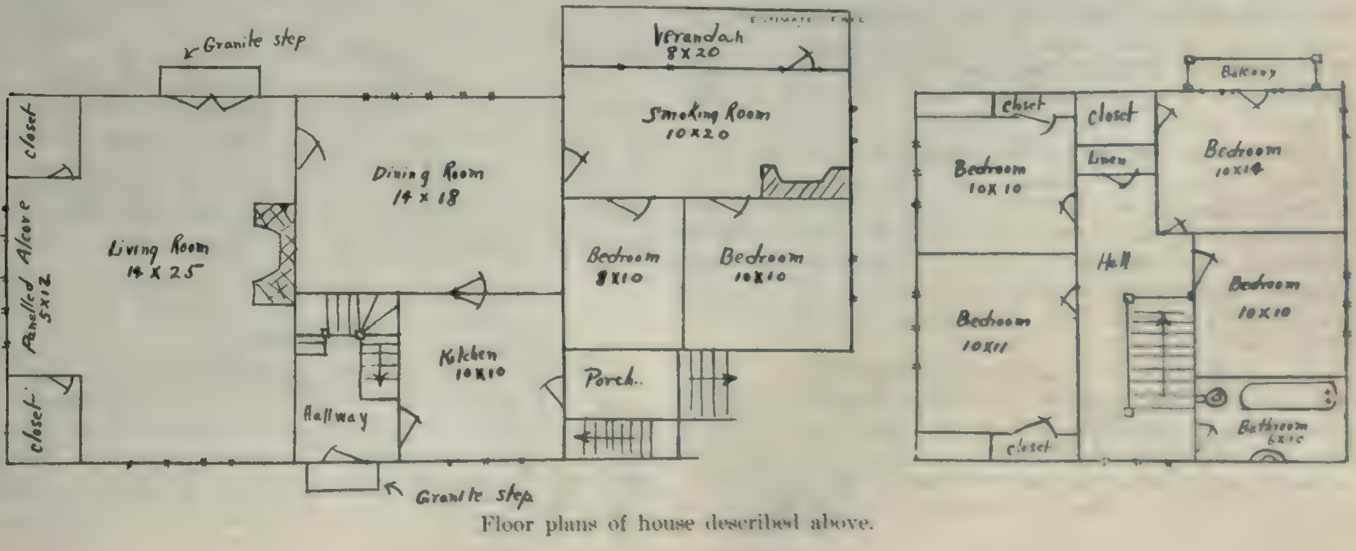
The dimensions of the house over all are 26 ft. x 45 ft. A very pleasing feature is the living room, with its beamed ceiling, panelled walls and well proportioned fireplace of locally manufactured pressed brick. The room is of generous size, being 14 ft. x 26 ft. with an alcove 5 ft. x 12 ft. while its French windows opening on to the garden, do much to enhance the general impression of ample and unrestricted space.

The porch step is made of dressed granite boulders found on the property. The hallway is tiled with red tiles, which give an air of warmth and comfort. Tiles are also used in the kitchen and bathroom, these being blue and white. The kitchen is conveniently fitted up with modern built-in features.

The exterior of the house is rough-cast. The two plans shown give the disposition of the rooms on the ground floor and the second storey respectively.

The small addition shown at the rear of the house was added after the main house was built. It was originally a cottage on the property and had to be moved about 200 yards to its present position. This proved a difficult and rather expensive undertaking and was done by special contract.

The house was built on a cost-plus basis with entirely satisfactory results.



Floor plans of house described above.

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## NEW TRACK CONSTRUCTION OF DETROIT MUNICIPAL RAILWAY

An extensive construction program is now being carried out on the street railway system of the city of Detroit, and it is expected that by the time winter sets in 82 miles of single track equivalent will have been completed. A monolithic type of rigid track construction employing International steel twin ties altogether, except under special work, is being used on the new work. The following particulars regarding this track construction are taken from the Electric Railway Journal.

This new type of construction consists first of 2 in. of rolled slag on the bottom of the trench, with a 1:2:4 mix of concrete poured from the slag up over the ties and base of the rails. After this has hardened, the remainder of the trench up to the level of the rails is filled with 2¼ to 3 in. crushed Wisconsin granite. This is rolled and then filled in with 1:2 grout and rolled again, forming what is termed "compressed concrete pavement." The rail used is either A.E.R.A. 7-in. 91 or 93-lb. plain girder or A.R.A. (which is also a standard of A.E.R.A.) 100-lb. 6-in. standard section rail, both sections being supplied by the Lorain Steel Company. The 93-lb. rail is identical with the 91-lb., except that the thickness of the web just beneath the rail head has been increased to ⅞ in., tapering to the standard thickness of rail web, 9/16 in., to a point between the rail head and the top of the bolt hole. The heavier section is used on those streets on which geatest density of traffic is expected, and it not only reduces the amount of concrete required by a depth of 1 in., but the price per ton is also less. The 100-lb. rail comes in 66-ft. lengths, while the 91 and 93 lb. sections come in 60 ft. lengths.

The steel ties are spaced 5 ft. 6 in. average centres and have the ends bent upward to give a cant of 1 to 25, thus providing for an inward tilting of the rails by the same amount.

The rail joints are made by using two 20 in. x ¾ in. plates, which are held in place by two 1 in. bolts and electrically welded along the top and bottom. The head and nut of each of the bolts are welded to the rail and the nut to the bolt. This welding is done by the short arc or metallic electrode process, using Wilson Welder & Metals Co. two-arc, gasoline engine-driven welding machines.

## Mainly Constructional

### East and West—From Coast to Coast

Fire losses during September according to the Monetary Times estimate, reached a total of $2,410,300, which is almost $600,000 less than August, 1921, and 70,000 less than September last year.

Building figures from Outremont, P. Q., indicate an increase this year of 53 per cent., to the end of last month, over the same period of last year. This year's figure shows a total value of $1,082,440, while last year's was $707,025

Traffic on the Canadian Pacific Railway, between Sault Ste. Marie, Ont., and the American Soo, was held up recently for a few days, owing to a break in one of the huge concrete supports of the international bridge at this point.

Over 2,500 men are at present engaged on the repairing of Toronto's street railway system, under the new Toronto Transportation Commission. This work has done much to relieve the unemployment situation in Toronto.

The estimated cost of the proposed extension of the T. & N. O. Railway, from Cochrane to New Post, Ont., a distance of 70 miles, is placed at $3,500,000. This amount includes the cost of necessary bridges, etc. A start will be made this winter on the clearing of the site.

There is a report current to the effect that the affairs of the Housing Scheme are being wound up in Ontario. Practically all of the $8,000,000, Ontario's portion of the original amount set aside by the Dominion Government for housing, has been used up and, although an additional Federal loan of $2,000,000 has been made available for this purpose, it is not expected that Ontario will apply for any of this.

The first meeting of the Montreal Branch of the Engineering Institute of Canada was held recently at the Institute's quarters on Mansfield St. Mr. Walter J. Francis, vice-president of the Institute, presented Mr. Roger French with the Gzowski medal for the most useful and meritorious technical paper presented to the society during the past year, the title of which was "Reinforced Concrete Covered Reservoirs."

Brockville, Ont., it is reported, has been selected as the new site for the Eugene F. Phillips Electrical Works, Limited. It is estimated that it will take three years to erect the new plant and transfer the machinery from the present plant at Mile End, near Montreal. The cost of the new plant will be between $2,500,000 and $3,000,000. The plant will consist of 11 units and will cover 15 acres. The first unit to be constructed will be the copper rolling mill, a building 375 by 125 ft., which, according to the agreement with the town, must be under operation within eight months of the ratification of the by-law by the ratepayers.

The following officers were elected at the recent joint meeting of the Ontario Association of Architects and the Royal Architectural Institute of Canada, held recently at Toronto. For the former association: President, J. P. Hynes, Toronto; vice-presidents, Messrs R. B. McGiffin, Toronto; Gordon Hutton, Hamilton; secretary, R. B. Wolsey, Toronto; treasurer, Gordon West, Toronto; registrar, Forcy Page, Toronto; council, Gilbert Jacques, Windsor; Gordon Hutton, Hamilton; J. P. Hynes, Toronto; S. Allaster, Brockville; Gordon West, Toronto; Forcy Page, Toronto; R. B. McGiffin, Toronto; Frank Kelley, Hamilton; C. P. Meredith, Ottawa; delegates to the Royal Architectural Institute of Canada, Herbert E. Moore, Toronto; J. P. Hynes, Toronto; Gordon Hutton, Hamilton; Charles S. Cobb, Toronto; C. H. Acton Bond, Toronto; and Gilbert Jacques, Windsor. The election of officers of the Royal Architectural Institute resulted as follows: President, David R. Brown, Montreal; vice-presidents, Professor Atcheson, Winnipeg, and Herbert Moore, Toronto; registrar, F. Page, Toronto; secretary, Alcide Chausse, Montreal. The next convention of the Institute will be held in Winnipeg early in September, 1922.

## Personal

Mr. H. L. Seymour, well known Toronto engineer, addressed the Athenaeum Club of the First Unitarian Church, Toronto, recently on city planning matters.

City Engineer Fuller, of Chatham, Ont., is one of the four Canadian engineers invited by the Portland Cement Association to make an inspection of the new highways in New York and district. Mr. Fuller has accepted the invitation. This is an annual affair.

Mr. D. Walter Munn has been appointed to chair of Mechanical Engineering, at the Provincial Technical College, at Halifax, N. S. Professor Munn is a graduate of the Faculty of Applied Science, McGill University.

Mr. Manley M. Maxwell has been appointed manager of the Chamber of Commerce, at St. Catharines, Ont. Mr. Maxwell has been connected for the past two years with the Chamber of Commerce at Chatham, Ont., in a like capacity.

Mr. S. Sylvestre, the retiring Deputy Minister of Public Works, of Quebec province, was presented with a valuable leather club bag, by the staff of his department recently. Mr. Gagnon, secretary of the department, delivered the address on behalf of the employees.

Mr. H. E. Fellows, C. E., assistant engineer of the Quebec Harbour Commission, has resigned this position to accept an appointment with the large engineering concern of Coode, Northway, Fitzmorris and Wilson, and will supervise a large engineering enterprise at Kilindini Harbor, Keryo Colony, British East Africa, for which the above firm were recently awarded the contract.

## Obituary

Mr. Francis F. Busteed, former general superintendent of the C. P. R., and well known railroad construction man of Vancouver, B. C., died in that city recently from heart's disease, after a short illness. Deceased was born at Battery Point, P. Q., 63 years ago and was a graduate of McGill University.

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## *Misleading Reports Underrate Canada's Construction Activity*

Foreign magazines sometimes make a show of reporting conditions in Canada. More often than not, these reports are wide of the truth, being merely the opinion of some individual whose report is regulated by the condition of his liver at the moment. A case in point is a three-line item in the current issue of "The Earth Mover," which sums up conditions in the construction field in Canada briefly, succinctly and finally as follows; "There is nothing very much doing in the construction line in this vicinity, (Montreal). Unemployment is very bad and we do not look for much improvement before spring."

There is no excuse for such a definitely pessimistic report as this either in Montreal or anywhere else in Canada. There is a lot of unemployment, it is true, though both the government reports and the trade union reports show that this condition is gradually improving. However, this is not a condition peculiar to Canada, but is common at the moment practically the world over. It is nonsense, also, to say that there is nothing much doing in the construction line. Reports for the first nine months of the present year, covering all Canada, show an appreciable gain in the amount of construction work carried out this year over the corresponding period of last year. Supply men are far from being pessimistic. Conversation with a brick manufacturer for example, a couple of days ago elicited the information that the demand for their product was very satisfactory. There is business to be had, if not in plenty, at least in very considerable amount, and the pessimist, in the main is the man who does not exert himself sufficiently to get out after this business.

In actual fact, there is a great deal doing in the construction field and a great deal in prospect. Taking Toronto as an example, the Transportation Commission are spending millions on rehabilitation and extension work; the Toronto harbor work is going steadily forward and a record number of homes, of the better class, are being erected. Just at the moment, comparatively little school work is being done, though considerable extensions are under way, and the demand for more accommodation is so insistent that new buildings cannot be delayed. The university's development program, which is also very urgent, will involve an expenditure of several millions.

Throughout the province, many large undertakings are under way, such as the Welland Canal, the Chippawa-Queenston development and a generous program of provincial highways and municipal work of various kinds the same remarks apply generally to other cities and provinces. To say that "there is nothing very much doing" in Canada, in the construction field, is very far from the truth—and conditions are decidedly improving.

## *The Government's Plans for Coping with the Unemployment Situation*

After careful consideration in the light of last winter's experience, and information carefully gathered, the Federal Government has determined upon a definite course of action to aid in fairly meeting the unemployment situation this coming winter. The policy outlined, and the principles upon which it is based, are briefly:

1. Unemployment relief always has been, and must necessarily continue to be, primarily a municipal responsibility, and in the second instance the responsibility of the Province.
2. That because of the present situation being due to causes beyond the powr of local, or even national, control, Provincial and Federal Governments should co-operate with municipal authorities in:
   (a) Helping to create and provide employment.
   (b) Where employmnt cannot be furnished to workmen who are willing to work, to aid in providing food and shelter for themselves and dependents until the present emergency period is past.
3. That Federal funds used for unemployment relief, or for relief work must be disbursed only through responsible municipal authorities, who in each case shall bear at least one-third of the total or extra cost.

The Government proposes to participate in the cost of work provided by municipalities on the following basis:

(a) Municipality to bear the normal cost, that is to say, the cost of carrying on the said work in the normal working season.
(b) Estimate of normal cost to be approved by Federal Government's engineers in the Department of Public Works.
(c) That Municipal, Provincial and Federal Governments bear equally and jointly the actual cost over the estimated normal cost, thereby encouraging the creating of employment where possible.
(d) That where work cannot be provided, the Federal Government continue to refund one-third of the disbursements actually made by a municipality for unemployment relief, conditional upon the Provinces participating on an equal basis.

By these means employment—instead of unemployment relief—can in most cases be furnished, thereby overcoming the only criticism of the Government's policy of last winter.

The Minister of Labor is communicating in detail the proposals to all Provincial Governments, copies of which will be supplied to any municipality interested on application to the Federal Department of Labor.

# High or Low Tenders?

## The Ottawa Council Decides to Accept Local High Bids in order to Provide Employment—Interview with Mr. John Quinlan

Should a civic authority accept the lowest tender? Should it accept a high local tender, passing over low outside bids, on the ground that the former will give employment to local men? The principles covered by these two questions are involved in the decision of the Ottawa City Council to accept the tender of Hooper Bros., Ottawa, for Indiana limestone, and that of the Ottawa Cut Stone Company for local or Queenston stone. The material is for the Ottawa civic hospital.

The decision meant the rejection of tenders by the Quinlan Cut Stone Company, Limited, Montreal, at prices some $9,000 lower than the ones accepted. This too in the face of a recommendation by the Hospital trustees that the lower bids be accepted. The recommendation came before the Council on October 13, when it was decided to accept the high bids. A motion for rescinding the resolution was immediately given, but on the 17th the Caüncil re-affirmed its decision by 11 votes to 10.

The ground for the decision was that the acceptance of the local tenders will mean work for Ottawa citizens, although it is obvious that the general taxpayer will have to find the additional $9,000. It may be pertinent to point out that the civic elections are not far off and it is not unfair to suggest that some of the members of the Council may think that an election cry of local work for local men will have an influence on the votes of a section of the voters. Be that as it may, the decision of the Council is to our minds fudamentally unsound. This is the view taken by the Ottawa branch of the Canadian Building and Construction Industries, and the directors of the Montreal Builders' Exchange, who protested against the decision, the directors of the Montreal Exchange reiterating their protest at the meeting of the City Council on the 17th inst. The view expressed was that the lowest tender should be accepted.

At the meeting, Controller Bliss very forcibly put the case for awarding the contract to the lowest bidder, in these words, "The tender system should be firmly established in Municipal Government. If there is any respect for the City's honour and respect the lowest should be accepted. There is no excuse for throwing away thousands of dollars, and I doubt if any one would take a similar course in his own business."

Mr. John Quinlan, the President of the Quinlan Cut Stone Company, in an interview with the representative of the "Contract Record", expressed views which we think will meet with general acceptance. "I believe," he said, "that practically every contractor will agree that the only principle which should guide civic authorities in awarding tenders is to accept the lowest bid, all other things being equal. The fact that guarantees have to be put up is sufficient protection to a Council in the matter of the work being satisfactory.

"The Ottawa Council advertised the job far and wide, presumably with the idea of securing competition and getting the lowest possible prices. Naturally the firms who tendered did so with the expectation that their bids would be considered on their merits, and that the lowest firm would be awarded the contract. The Council have departed from a recognized business principle, and in my opinion those outside firms who tendered have strong cause for complaint. If only local bids were to be considered, then the Council should have stated so in their advertisement. There is also this to be said—If Councils confine their contracts to local firms with the idea of employing local labour, the result will be, as in this case, great increases in the cost of work, as experience shows that limited competition results in higher cost.

"Another aspect of the case is the unfair expense to which the contractors who bid were put. The firms who bid incurred a certain amount of cost in drawing up their tenders—in the belief of course that they would secure the work if their bids were the lowest. Naturally they would not have gone to the trouble and expense involved had they known that local tenders would have the preference, notwithstanding a very heavy difference in price.

"The question of the extra $9,000, which will come out of the pockets of the general taxpayers, is of course a matter largely for Ottawa citizens. But on general principles it is questionable whether the unnecessary expenditure will achieve the object in view —the provision of work for local men. The extra money to be spent means that the citizens are $9,000 poorer than they should be, and the action of the Council reduces the purchasing power of the general body of citizens to that extent. I am, of course, more concerned from the point of view of the contracting interests, and I am very srongly of the opinion that the decision of the Council is against the best interests of the industry as a whole." If the example of the Ottawa Council is adopted by other civic authorities, it will undoubtedly limit competition and increase the cost of municipal work to such an extent that work will not be carried out owing to the high cost.

It may be doubted whether the members of Councils have sufficient expert knowledge to intelligently decide the awarding of contracts of this character. The votes of the electors are calculated to influence their decision in such matters, and the case at Ottawa furnishes evidence that circumstances have a strong bearing on the judgments of the aldermen. The better plan would be, I submit, to have the awarding of such contracts in the hands of civic experts, such as engineers or architects—men who are in a position to know the best way to secure economical results."

*No. 66*

## *Canada's Engineers—Arthur Crumpton*

The Honourable William Howard Taft, Chief Justice of the Supreme Court of the United States, recently stated that he had been impressed by the loyalty and esprit de corps of the officers of the Grand Trunk Railway, many of whom had grown up with that company, and the record of the subject of this sketch is a striking illustration of Mr. Taft's statement.

Mr. Crumpton, valuation engineer of the Grand Trunk Railway System, is a Torontonian by birth and education. Although still in the prime of life, he has been railroading for 38 years, having started as a boy in Toronto on the old Northern & North Western Railways, where in the general manager's, accounting, mechanical, purchasing and engineering departments he gained a general knowledge of railway work.

In 1896, after the absorption of the North Western by the Grand Trunk, Mr. Crumpton was appointed to the headpuarters engineering staff of the latter railway in Montreal, and his engineering experience since that time has been coincident with the growth of the system, as he has been intimately associated with its larger engineering betterments, such as the completion of the double tracking of a thousand miles of its main lines, the installation of bridges of the heaviest class from the Atlantic to Chicago, including the reconstruction of the Victoria Bridge across the St. Lawrence River at Montreal, the revision of existing lines, and the location and construction of new lines in the provinces of Ontario and Quebec, and in ten of the neighboring states.

Mr. Crumpton is a member of the Engineering Institute of Canada, the American Society of Civil Engineers, the American Association of Engineers, the American Railway Engineering Association, The Corporation of Professional Engineers of Quebec and is president of the Canadian Railway Club, which is one of the largest clubs of its kind on the continent, having over thirteen hundred members, scattered throughout Canada and the United States.

Mr. Arthur Crumpton.

# Mount Royal Hotel Progress

## Headway Being Made on Huge Montreal Building—Foundation Conditions are Proving Excellent—Excavation is Half Completed

The construction of the Mount Royal Hotel, at Montreal is now well under way. The building, located on what is known as the old high school property on Peel Street immediately north of St. Catharines Street, will be ten storeys in height, 309 ft. long, facing on Peel Street, by 229 ft. 4 in. deep, occupying an entire city block. The foundations will consist of circular caissons sunk to rock with reinforced concrete exterior retaining walls. The frame work of the building is to be of structural steel with reinforced concrete floors.

The excavation is now half way completed and work has been commenced on the sinking of the caissons. What may be considered as very favorable conditions have been found to obtain, as rock at the lower end of the lot is found at only 30 ft., approximately, below the surface of the ground, while at the upper end of the lot the rock is approximately 1 ft. below its elevation at the lower end, but the surface ground rises 13 ft., leaving the rock at approximately 44 ft. below the surface at the upper end. The excavated material consists principally of blue clay which reaches close to the surface of the ground. The clay has not been found stiff enough to permit of free standing excavation, but up to the present time practically no water has been encountered. The rock surface on which the caissons are to rest consists of a hard variety of black limestone. In the clay which lies above the limestone some boulders have been encountered indicating glacial drift.

The architects for the building are Messrs. Ross & Macdonald; the general contractors are the Thompson-Starrett Company, Limited. Mr. R. E. W. Hagarty is consulting engineer to the architects in connection with the foundations and structural frame work.

# Don't Be Afraid of Winter---Carry on Concreting Without Interruption

## No Difficulties or Expense Need be Experienced in Constructing Concrete Buildings During the Cold Weather if Simple Precautions are Observed—Many Advantages to Winter Operations

By A. C. IRWIN, Engineer, Structural Bureau, Portland Cement Association.

The season is approaching when some contractors will be thinking more of storing their equipment and abolishing their payroll than of going ahead with work for the winter. Instead, there are 57 varieties of reasons why every contractor's mental energy should be devoted to finding out how he can at least keep his organization together, his equipment in good working condition through use, and very probably make some money during the winter season and thus show more life than the hibernating animals that exist on the accumulated fat of the mild season.

Cold weather work has no problems which have not been successfully met, nor does it contain uncertainties worth while considering beyond those surrounding every important construction job. The contractor who undertakes construction that will run him through the winter months knows beforehand that the worst that may be chargeable to cold weather work is simply a matter of temperatures. If he provides at once for carrying on the work continuously during cold weather, he will have more than safe-guarded himself because if the job is an extensive one, certain portions of it will be carried on during mild weather when the maximum precautions against extremes of temperatures need not be taken.

There are other important reasons for continuing work throughout the winter than the contractor's interest. The economic condition of the world demands that no cessation of work take place with consequent delay in the completion of needed construction. While economically, the worst of the reconstruction period is behind us, the competitive period, when he who is best equipped for business will win, is immediately ahead of us. The owner who gets a running start by utilizing the winter time to complete his plant ready for business, whether that plant be for manufacturing, retailing, renting or selling will be rewarded by the advantage of early profitable use.

### Many Economies in Winter Work

Any extra cost of winter work is a result of weather conditions, but experience shows that with adequate provision for carrying on winter work there are certain advantages which in many cases completely offset the expense of cold weather work and one contractor who builds millions of dollars worth of concrete buildings yearly states that he does not hesitate to recommend owners starting construction during the winter months because economies obtained through favorable labor and material market conditions in the winter season often equal any extra cost. Labor as a whole is more abundant and efficient and the job can be manned with the best of the labor market. During the winter months also, the demand for construction material lets up because the enormous number of small jobs not worthy of especial cold weather methods are then suspended. Under these conditions it is well known that materials can be purchased to advantage. At the worst, contractors have found that the cost of winter concrete work is only from 3 to 10 per cent greater than that of the same work in summer. Under conditions slightly more favorable than average winter weather we may reasonably assume that there will be practically no added cost for cold weather work.

As an indication of how concrete construction may proceed in spite of frost and snow, this illustration is full of interest. It shows the structural frame of the Calgary Herald Building, Calgary, Alta., being constructed during continuously freezing weather with occasional temperatures of two degrees above zero.

In considering what must be done to secure success in cold weather concreting it is only necessary to keep in view the one fundamental thing, namely, temperature. The concrete should not be allowed to alternately freeze and thaw. Any method or device that will prevent this is all that is necessary to secure successful results. Concrete that has been kept at a temperature of about 60 degrees for four or five days may safely be exposed to low temperatures. This means that only the portion of the building where work is in progress need be protected or that sufficient heat must be supplied to the concrete materials and provision made to retain this heat until the hardening process has continued unchecked for at least 96 hours.

Live steam is a most effective way of removing ice and snow from forms and reinforcement before concreting.

### Cold Weather Precautions

The usual methods of cold weather concrete work have been described in various issues of the Contract Record and will not be repeated here. A summary of them, however, may be given with propriety.

Both aggregates and mixing water should be heated, but care should be taken that when the water and aggregates are combined the resulting temperature will be less than the boiling point of water. It is not a difficult matter to heat aggregates to a temperature considerably above the boiling point of water so that they may be injured in coming in contact with the water, or so that a loss of mixing water may take place through rapid evaporation or the creation of steam.

Concrete when placed in the forms should have a temperature not less than 70 degrees F. A temperature of 100 degrees F. is entirely practicable and may be given as a standard temperature for concrete when deposited in forms.

The forms and reinforcement should be entirely free of ice and snow and the forms and reinforcement should be warmed just prior to placing the concrete. A method of warming forms and reinforcement is shown in Figure 1. This method consists simply in shooting a jet of live steam onto the forms and reinforcement in place just prior to placing the concrete. It is interesting to note also in passing the wheeling platform for transferring the concrete from the elevating tower to the forms instead of the all too prevalent method of flat angle chuting.

### Retention of Heat

After the concrete is in the forms provision should be made to retain the heat. This is done by covering the concrete with some form of insulating material, or better still, enclosing it and supplying heat within the enclosure. The method of making the enclosure is a matter of choice and will be governed to a large extent by available materials. The most common method is to use tarpaulins, but occasionally one or two stories of a building are entirely closed in with light wooden side walls. In supplying heat to the interior, it should be remembered that warm air has a much higher point of saturation than cold air and that unsaturated warm air will permit rapid evaporation of moisture from the concrete. For this reason the best method of heating the interior of an enclosure is by the use of live steam. Steam can be delivered through perforated steam pipes close to the concrete and thus supply not only heat but moisture so that the concrete may harden under very favorable conditions.

If live steam is not available, coke salmanders or stoves are often used, but with these large pails of water should always be placed upon them so that the air is kept well supplied with moisture. In a proper enclosure, one coke salamander will be required for every 500 to 800 sq. ft. of floor area.

Much has been said in regard to the ability of concrete to withstand low temperatures without special methods of protecting it. Arguments have been advanced that because a certain amount of heat is generated by the chemical reaction of the water and cement, or that some anti-freezing compound lowers the freezing temperature and accelerates hardening, no special precautions need be taken. While it is true that a certain amount of heat is generated in the concrete during early hardening, this should not be taken as a reason for lack of protection. If the materials are cold when the concrete is placed, there is no hardening and no chemical action, therefore no heat developed. The result is obvious. Heat should be supplied to the materials in all cases where temperatures below 40 degrees are to be encountered.

### A Cold Weather Hint.

**When prevailing temperatures range between 40 and 50 degrees Fahrenheit, a sudden drop to freezing or below may occur.**

**Concrete must be protected against freezing until early hardening has been completed.**

**Therefore when the temperature ranges between 40 and 50 degrees, aggregates and mixing water should be heated so that the concrete when placed in forms will have a temperature of not less than 70 degrees Fahrenheit. Immediately after placed, suitable protection should be given to prevent freezing or loss of heat.**

**Leave forms in place until concrete is strong enough to be self-supporting.**

### Anti-Freezing Compounds Not Reliable

The other excuse for lack of protection, namely, use of some anti-freezing compound, is based on reasons little better than that just referred to. The only value of an anti-feezing compound exists in its accelerating effect on the hardening of concrete or on lowering the freezing point. But reliance should not be placed on these methods since the range of temperature which will be taken care of by them is very limited and the risk that this range will be exceeded is too great to be taken since frozen concrete may have to be taken out and replaced. The other objection to the use of the anti-freezing compounds is the fact that almost without exception they reduce somewhat the resulting ultimate strength of the concrete unless used in very small quantities and in the latter case the object of using them—namely, to permit concreting in cold weather—is defeated.

The points that should be observed in cold weather concreting can be summarized as follows:

1. The temperature of the concrete when deposited should be well above 70 degrees F.
2. The mixing water should be as near the boiling point as possible.
3. All materials should be heated when air temperatures average around 40 degrees F. or below.
4. The concrete should be kept at a temperature around 60 degrees F. for at least two days and in very cold weather for four or five days.
5. Steam is preferred for heating aggregates and concrete rather than stoves because it supplies a moist heat.
6. Forms should not be removed until all danger of collapse has passed. Where the slighest doubt exists at least 10 square feet of the concrete should be heated with hot water or steam to determine whether it has hardened or merely frozen.
7. The fundamental principle is to provide sufficient warmth and moisture for the proper hardening of the concrete.

# Water Supply Improvements for the Town of Bagotville, P.Q.

## Scheme to be Placed in Operation Next Month Involves Gravity Supply Giving Pressure of 125 lbs. at the Main—No Involved Intake Works Necessary

By the Contract Record's Quebec, P. Q., correspondent.

One hundred thousand dollars are being spent for extensions and improvements on the water supply system of the town of Bagotville, Quebec. The present water-works have been in operation since 1913 and are owned by the municipality. Water was pumped from River a Mars directly into mains and was distributed through over two miles of 6 in. to 2 in. pipes. The pumping station, at the intake, was operated by water wheels working under a head of 8 to 10 feet and developing 25 to 40 h.p. The turbine required about 80 times the amount of water pumped into the mains and it was found, that, at low water stage, the supply was insufficient, the pressure obtained by the centrifugal pump being only around 50 lbs per square inch.

During the last five years the town of Bagotville, which is situated on Ha! Ha! Bay, practically the head of deep-water navigation on the Saguenay River, developed considerably. The construction of the Ha! Ha! Bay Sulphite Coy's mills, of the new town of Port Alfred nearby, and of large deep-water wharves, brought much activity and resulted in a notable increase in the population of Bagotville.

It was then decided to improve the water supply system and do away with the old pumping station. Plans were prepared by J. F. Grenon, consulting engineer, Chicoutimi. They provided for a gravity system supplied from River a Mars with the intake a little over five miles from the present pumping station. Over a 300-foot static head will be obtained and the normal pressure in the town is expected to be over 125 lbs per square inch.

Cast iron pipes of 16 in. to 6 in. diameter, supplied by the Canada Iron Foundries, Limited, were bought at a cost of $60,000.00. The general contract for laying the pipes was awarded to Messrs. Emile & Alfred Gagnon of Jonquieres.

The pipe line is being laid for a certain distance by the side of a road but, at the upper end, the pipe crosses the river under water and the trench is made in the bush on a length of over one and a half miles. The trenching was done at a cost of 15 to 40 cents per running foot depending on the nature of the excavation, which prices, of course, do not apply to places where blasting was required. At the upper end, coarse gravel and boulders were found and one of the main difficulties there was to secure the proper material to bury the pipe with.

An ideal location has been found for the new intake. It is being excavated in solid rock on top of little falls which drop about 10 feet and where Nature has provided a regular dam and forebay, so that no such works need to be made.

At the lower end, the new pipe line will be connected to the present 6 in. mains.

The work has been carried out so far very successfully and it is expected that the new system will be put in operation early in November.

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### Montreal Architect Takes New Office

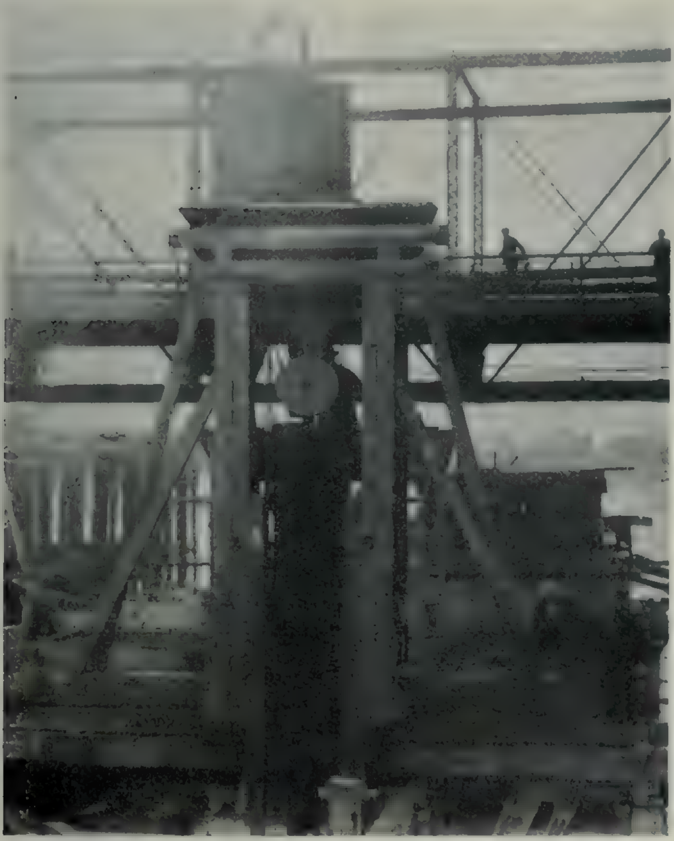
Alfred G. Nosworthy, architect, formerly at 304 Union Street, Montreal, has taken offices at 204 St. Catherine Street, West, where he has reopened for the practice of architecture and construction engineering. Mr. Nosworthy is a member of the P.Q. Association of Architects, and of the Royal Architectural Institute of Canada.

# Rapid Progress on the Construction of the Johnson St. Bridge, Victoria

## Concrete Operations on the Substructure are Proceeding Speedily—Special Scheme for the Underwater Pouring of Concrete—Caissons Sunk to Depth

By the Contract Record's Victoria, B. C., correspondent.

Construction is now proceeding rapidly on the substructure for the new highway and railway bridge being erected on Johnston St. by the city engineer's department of Victoria, B. C. The east abutment is completed as far as possible without disturbing the existing bridge, which is to remain in service until such time as temporary tracks can be laid across on the highway portion of the new bridge now being built. Forms have been built for the corresponding section of the west abutment, and concreting is in progress. Two caissons have been sunk to depth and the larger of the two which will enclose the main trunnion pier, has been concreted to a depth of 14 feet. This caisson was not carried down to bed rock, which in this part of the channel is from 70 to 90 feet below ordinary low tide level, but piles have been driven at close intervals all over the enclosed surface to bed rock and cut off so that their tops are at a level about 5 or 6 feet below the harbour bottom. Previous to driving the piles excavation was taken down far enough to allow a projection of the pile tops, after cutting off as described, of about 4 feet, so that a thoroughly good bond would be obtained between the piles and the concrete filling of the caisson. The caissons have been so built as to allow the upper portion to be removed with very little trouble by simply releasing a few bolts, after the pier proper has been built.



Pouring concrete under water on Johnson St. bridge, Victoria.

For the purpose of pumping out the caisson a centrifugal pump of 5000 gal. per minute capacity, steam engine driven, has been installed, and has been successfully tried out. Several leaks developed in the walls of the caisson, but none was serious enough to suspend operations, although the diver's services were requisitioned to undertake some calking on the outside of some of the joints.

For keeping down the water after the preliminary pumping a four-inch centrifugal pump has been installed, belt driven from a traction engine, and in its try-out has proven entirely satisfactory. An attempt was first made to use an old Waterous fire engine in the possession of the city, but while this pump was in excellent condition, and gave good service as long as clear water only was being pumped, it gave out when the attempt was made to pump water containing a large proportion of silt.

### Special Method for Concreting Under Water

To overcome the difficulties of concreting under water, the city engineer, Mr. F. M. Preston, in collaboration with the resident engineer on the bridge, Mr. F. H. Allwood, worked out a very simple and effective arrangement which appears to have satisfactorily solved this somewhat vexed problem. The arrangement partakes of the characteristics of the closed bucket and of the tremie systems of underwater concreting, and consists of a cylinder, closed at both ends by movable traps, which are so constructed as to be practically airtight when closed. A batch of concrete is put in the cylinder with the lower trap closed, then the upper one is closed and the whole lowered to about two or three inches above the point where the concrete is to be placed. Air pressure is then applied above the concrete before the lower trap is opened, so that the batch is forced out rapidly and evenly, with as little contact with the surrounding water as is at all practicable. Samples of the concrete detached by the diver after setting show a dense firm structure of satisfactory hardness and with all the grains of sand and gravel well coated with cement. As applied in this job, the concrete cylinder is supported between guides after the manner of a pile driver, and is skidded about as required. It would seem to be entirely within the bounds of possibility to use the contrivance at the end of a line controlled by a derrick, which would increase its flexibility considerably for some classes of work.

# The Waterproofing of Highway Surfaces

## The Subject of Discussion at the Second Meeting of the Toronto Branch, E. I. C.

The chief topic of discussion, at the second weekly meeting of the Toronto branch of the Engineering Institute of Canada, was "The Waterproofing of Highway Surfaces." The chairman, Mr. George Clark, in introducing the subject, referred to the close financial conditions that have prevailed for some time past, which have had their effect upon the paving industry along with all other industries, causing operations to be held up at many points. He was of the opinion, however, that conditions along this line were generally improving and looked for the completion of a large section of Ontario's 1,800-mile provincial highway system next season. The present time, therefore, he pointed out, was a most opportune one for the discussion of this very important subject of waterproofing surfaces.

Mr. Geo. G. Powell.

Mr. Geo. Powell, deputy city engineer of Toronto, was the first speaker. In relating his experiences in road building, while supervising the construction of streets in Toronto for several years, he spoke favorably of the waterproof qualities of some of the older types of roads—brick and granite set—which had been discarded, except for street intersections or grades in some places, largely on account of their noise and the fact that the materials were of foreign manufacture. The treated wooden block pavement, although very expensive, when properly laid and impregnated, gave a highly waterproof roadway, he said his experience, however, had been more with later types of roadways —asphalt, bitulithic and asphaltic concrete. Toronto, at the present time has many millions of yards of asphalt roads, some laid on a concrete base and some on old road foundations, but all of which he considered of a highly waterproof nature. He went into detail, explaining the methods of laying these roads, the materials for which are mixed in the city's plant. These roadways, when completed, he stated, present a very close grained appearance and, under normal conditions, are entirely waterproof. Some of them have been down for seventeen years on streets, if not with a decidedly heavy traffic, at least with a fair traffic, and had cost very little to maintain.

### Bituminous Types

He next dealt with the bituminous or asphaltic concrete pavements in Toronto, going into detail again as to the method of laying these roads. Many examples of this type of road have been down for from ten to twelve years and like the asphalt, present a highly waterproof surface which has cost very little to keep in repair. Touching on the formation of different types of asphalt, both natural and prepared, he expressed the opinion that the selection of asphalt should be based on the percentage of bitumen content, the higher content being more desirable. He also emphasized the importance of expert workmen and supervision, explaining that an asphalt roadway could be spoiled, for instance, by the use of improper sand in the aggregate. He had no doubt that all failures in this type of roadway were due to the inexpertness of those entrusted with the laying of them.

While Toronto's roadwork had been laid largely by the mixed method, he stated that excellent results can be obtained by the penetration method in places where it is not advisable to erect a mixing plant. With the modern machinery developed in recent years, for the application and proper distribution of the material over the road surface, this method of construction had become considerably simplified. He strongly favored the application of the second seal coat after a period of 6 months of traffic travel, assuring his listeners that the results obtained by this action were worth considerably more than the cost of carrying it out. He spoke highly of the product Tarvia "A" for surface treatment for roadways of light traffic. This surface coat can be applied to an inexpensive waterbound macadam road, giving an economical roadway, suitable, as stated, for the lighter class of traffic. He also advocated the use of asphaltic oils and tars for dust layers.

In closing, Mr. Powell stated he was considering the use of the product super-cement on a short section of roadway in the near future and asked for comments from any who might have had experience with this material.

### Surface Relatively Inexpensive

Mr. Procter, of the engineering firm of James, Procter & Redfern, Toronto, was the next speaker. He took the opportunity of impressing on the many engineering students present at the meeting, the importance of keeping in close touch with highway legislation in the province in which they lived, and referred to the increasing recognition, on the part of municipal, county and governmental bodies, of the value of expert engineering advice in the development of their respective highway systems. He also presented some interesting figures in connection with roadwork supervised by his firm in Orillia, Ont. some time ago. The total expenditure involved was $235,000, 9 per cent. of which was spent in excavation work; 12 per cent. for curbs and gutters; 15 per cent. for storm sewers, catch basins, etc.; 22 per cent. for base, and 42 per cent. for bituminous top. Since but 42 per cent. of the cost of the work was expended on the all-important wearing surface, he strongly recommended the expenditure of a few extra cents per sq. yd. on the securing of a high grade, waterproof top. Mr. Procter also had a word to say about the importance of expert supervision, laying particular stress on the matter of proper grading.

Mr. L. M. Jones, formerly city engineer of Port Arthur, Ont., and recently connected with the well known firm of contracting pavers, The Warren Bituminous Paving Company, at Toronto, followed Mr. Procter. He strongly advocated the annual waterproofing of roadways, by the application of a coat of Tarvia, claiming that a roadway treated in this way could be kept in better condition and would be maintained more economically than if the road were let go for ten years, say, and then brought again to a state of repair. He submitted figures in support of this statement. The speaker then went on to outline the methods and machinery used by his company in the carrying out of their road contracts. Mr. Jones was of the opinion that the engineers could do much in educating the municipal and government officials in the importance of letting road contracts early, so as to allow the contractors to utilize the entire road building season for actual work, and thus assist the latter to sustain the heavy financial load imposed by large machinery investments, heavy overhead and depreciation charges, etc. A sore point, Mr. Jones said, too, was the required three to five-year guarantee for roads. The roads were built exactly to the specifications of highway engineers in every detail and he did not think it fair that the contractor should be taxed with the responsibility for its standing up under the ravages of weather, etc. He thought it was merely a matter of passing the buck to the contractor.

The last speaker, Mr. A. E. Jupp, of the Jupp Construction Company, of Toronto, gave a very interesting short talk on the penetration method of road construction which has been carried out by his firm on many jobs throughout the country. He illustrated his talk with chalk, making very clear the progress of the bituminous material from the railway tank cars to the actual incorporation in the road bed.

A pleasing feature of the meeting was the very large attendance of student members, the accomodation being taxed to capacity. Mr. Jones of the Warren Company, and Mr. Smith, of the Barrett Company, extended invitations, especially to the younger men, to visit their respective plants, for the purpose of examining and inspecting the various machinery and processes.

The meeting came to a close after an interesting general discussion taken part in by the above mentioned speakers and Messrs. Clark, Oxley, Dalzell, Smithers, Storie and others.

# Who Says Times Are Bad?

## Reports from Many Centres Show that Building is Not as Inactive as Some People Would Make Us Believe

### Boom is Expected in Quebec

In spite of the fact that only 64 building permits totalling $113,533, have been applied for in September, the city engineer of Quebec city confidently predicts a flood of building operations in Quebec and that the total value of property completed in 1921 will pass the three million dollar mark.

In September, 1919, 64 permits were issued with a total value of $282,565, while the value of the 42 permits issued for the same month in 1920 totalled but $174,290.

Figures of the first nine months of this year, however, constitute almost a record in the history of the local city engineer's office, for the total value of all permits issued to date of this year is $2,686,874, a larger sum than any other full year with the exception of 1914. The entire year of 1914, however, was but a scant $72,000 ahead of the total for but the first nine months of 1921.

### Building in Ottawa is Brisk

Evidence that building operations in Ottawa are brisker than for some time, and that there is considerable work for men in the building trades, is obtained by a survey of building going on now in the city.

The total value of building operations in Ottawa, started in September, was $510,260, which in the opinion of the building inspector's office, is an unusual showing for this time of year and in view of building conditions. The two biggest jobs going on are the Civic Hospital, main building, a $140,000 contract, where there are 150 men, mostly carpenters and laborers, now employed, and Ottawa Dairy, Ltd., extension on Somerset street, a $75,000 job with 50 men employed.

On Sparks street some activity prevails on the premises to be occupied by the L. R. Steele Co., Ltd., on south side of the street between Metcalfe and Elgin streets. There are about 155 men on the job, who are working 11 hour shifts, night and day, in order to have the contract completed by Dec. 1, the scheduled time. The Graves Construction Company has the job.

Work on the premises to be occupied by the Home Bank and the Bank of Toronto on Spark street, south side, between O'Connor and Metcalfe streets, which has been in progress for some time, is also using the services of quite a number of men. The A. I. Garvock Contracting Company has this job.

Messrs. Cowie and Moore are erecting a solid brick garage on Lots 17 and 18, Albert street, between O'Connor and Metcalfe streets, dimensions 122 feet by 95 feet. It will be a two-storey structure and the interior work will soon be under way. This garage is being erected by Dr. R. M. Graham and Dr. W. H. Graham.

Permits for about 95 homes of all kinds were taken out in the month of September, many of these being for homes in Ottawa South. Several very fine residences are going up in that section of the city.

Excellent progress is being made on the main building of the Civic Hospital, work being now carried on, on the third floor.

# Sound Basis for Municipal Water Rates

## Paper Presented Before the American Water Works Association Makes an Analysis of the Factors Involved in the Marketing of Water, with a View to Determining a Scientifically Computed Service Charge

By E. E. BANKSON, D. E. DAVIS and C. A. FINLEY

(Continued from last issue)

### Distribution of the Burden

Meter rate schedules are generally one of three types: (1) Straight price to all per 1000 gallons, (2) minimum charge type, (3) service charge type. Nos. 2 and 3 are on the basis of either a straight price or a sliding scale in addition to certain fixed charges. It is generally conceded that it costs more per 1000 gallons to serve a small than a large customer. If this fact be admitted, we thereby eliminate the straight price or flat-price-to-all idea.

A minimum charge type sliding rate schedule can be constructed which would closely approach the costs of rendering the service, but the Public Service Commission of New York has ruled against the minimum charge type in a gas case in the following words which apply equally well to water:

### The Minimum Gas Rate is Inequitable

A sample case cited is the best proof. Mr. A. and Mr. B. are in the minimum class, which is placed, say, at $1. Mr. A. used 90 cents worth of gas a month; he pays $1.00. Mr. B. uses 20 cents worth of gas a month; he also pays $1.00. If the interest on the service investment to that residence or office is 50 cents, the company sustains a loss from Mr. A. of 40 cents that must be made up by some other consumer, while it has made a profit of 30 cents off Mr. B.

The service charge is recognized by the New York Commission in these words, "A service charge ......is a legal and just charge if properly adjusted as to amount." The association of Boroughs in Pennsylvania, on advice of their counsel, has recently withdrawn a proposed bill intending to make the service charge illegal in Pennsylvania. These and many other incidents seem to indicate to the writers the increasing recognition of the service charge.

### Service Charge Limitations

Advocates of the service charge have included portions of the total annual burden under this charge, ranging all the way from "simple consumer charge" to "entire fixed charge and overhead expense."

The writers maintain that a proper service charge is usually in excess of a simple consumer charge, but much less than the total fixed charges and overhead expenses. They have developed principles on which the service charge may fairly be computed, as indicated in two examples appearing at the end of this discussion. The service charge is based on the assumption that a company stands ready, under certain expense, to do a service or sell a commodity for which no purchaser may materialize. Insofar as it is compelled to do so or is reasonably in danger of having to do so, the company is undoubtedly entitled to financial remuneration and to have its financial position insured.

It is not a fixed condition that may be applied empirically to all plants, but exists between two limitations which may be designated as the maximum service charge, where the plant stands ready to deliver and no water is taken, and the minimum service charge where the size, diversity, and variety of consumers maintain practically a constant demand on the plant.

It is assumed that in order to warrant any service charge, it must be shown that the conditions on which it is based actually exist. It must be a real condition and not based on any theory of what might or could happen. It must be based on common sense and actual facts developed from the operating conditions of the plant in question.

The full or maximum service charge may be outlined as that of a plant fully manned, with reservoirs full and pipe lines under pressure running at a rate just sufficient to offset leakage losses, but with no one taking water. The minimum service charge may be conceived as one in a plant whose customers maintain a constant cycle of demands on the plant and where there is no loss due to standing ready to serve.

A typical example of the maximum service charge condition would be a plant having one customer taking the entire output, but taking it at such irregular times and in such uncertain quantities that the plant was compelled to keep its entire equipment ready for operation at a moment's notice. The cost to this plant, even when no water whatever was taken, might easily be 90 per cent or more of its full operating cost. The plant in this case is rendering what may be typically designated as a service, as distinguished from the sale of a commodity. It is, therefore, entitled to remuneration for this service. The service in this case financially predominates over the sale of the commodity.

A representative type of a minimum service charge may be taken as that of a large city plant having, say 100,000 customers, whose varied demands on the plant impose on it practically a fixed cycle of conditions hourly, daily, weekly and seasonally. Such a plant is usually so designed that it is practically at no actual expense on account of standing ready to serve a commodity for which there is no purchaser. Its function is the sale of a commodity, as distinguished from the readiness to sell. Practically speaking, the maximum loss directly imposed by failure of a purchaser is the loss incident to the service line, the meter and the reading and billing. With these determined they may be designated as a minimum service charge, as distinct on the other extreme from a maximum service charge. The maximum service charge may be considered in its application to a certain large city plant where the average rate for water is about 15 cents per thousand gallons and serves about 100,000 customers. If the theory of the service charge be carried to its logical sequence and it is assumed that all customers withdraw their patronage, the expense of this plant would still be over 90 per cent of its active operating cost. If this 90 per cent were provided for in a service charge, the price of the water would be about 1½ cents per thousand gallons, with the result that the plant would be on a flat rate basis and meters would be of no practical value. As a matter of fact, this plant (aside from fire protection) is not primarily in the business of furnishing a service but of selling a commodity. It suffers practically no financial risk or possible embarassment from standing ready to serve. It does lose the interest and maintenance on the meter in addition to the billing charges, when the customer fails to buy and is entitled to collect for this in the event of the customer's failure. The two extremes in the type of plant have been taken to show the wide possible range of a service charge designed to meet the financial risk imposed on a plant standing ready to serve. At one extreme, the service cost takes precedence over the commodity charge and amounts to pratically the whole bill. In the other instance, the commodity charge takes precedence and nearly absorbs the service charge. The range of possibilities between these two extremes is infinite.

In the case of the Consolidated Ice Company vs. the City of Pittsburgh, it was necessary, in the interests of the city, to combat a theory which developed a high service charge and a low commodity charge, and we quote from the testimony of Mr. Finley in that case as follows:

To maintain this condition in the Pittsbugh Plant, even if no water were sold, means the pumping of about fifteen gallons per year to keep the plant full. The cost of supplying these fifteen billion gallons, instead of the forty-five billions now handled, would be a large percentage of the present cost, substantially the entire cost except as follows: the saving due to not pumping the thirty billion gallons which the consumers now use would be about $350,000.00 (out of a total annual burden of about $2,650,000) and the ready to serve charge would be the total cost of production less this $350,000.00. If now the suggested method of allocating this charge according to the suggested basis in fixed quantities against the consumers is adopted and the $350,000.00 is allocated amongst the cansumers according to the amount of water used, then to all practical intents and purposes, the city is back again on a flat rate assessment basis, except for the fact that consumer, in addition to the fixed amount laid up against him, would pay something over one cent a thousand gallons for the water consumed. This means that the entire economic value of metering would disappear. There would be no check on the waste of water, no personal interest on the consumer's part to eliminate waste and the unnecessary outlay of capital in order to handle this waste would then obtain.......If the art of supplying water to large communities is to make any economic progress, and there is no question as to the desirability of this end, it must not be defeated by any false rate hypothesis which takes but little account of the amount of water used and virtually harks back to the flat rate theory based on what might, or could, or should be demanded of the plant. The water meter is the instrument by which great advance in the economy of the art is to be affected. It introduces the element of self-interest in the relation of the consumer to the producer and produces a result which no amount of inspection, argument or propaganda can accomplish. It shows on its dial just what has happened to the plant regardless of the value of any orifice and what it might or might not have demanded. It reveals the big customer and the little consumer in their true relations and it is not surprising that many rate schemes have been developed, the purpose of which has been to defeat the objects of metering and to escape the responsibility of paying in accordance with the meter readings. Any such rate scheme which submerges the retarding influence of the meter, on waste water, smothers the greatest opportunity for economic advancement available at the present day in the art of supplying water.

## A Proposed Method for Distribution of the Burden

The usual assumptions underlying the construction of rates are that the total revenue to be derived may be divided into three broad classifications, which roughly correspond to the costs. These are the consumer, demand and output costs. The consumer costs are taken as those costs (actually derived from a study of the company's books) which cover the reading of meters and billing of charges, book-keeping costs, stationery and those costs which have no reference to the quantity of water used by the consumer, but which are practically the same for each consumer regardless of size.

The demand charge in bulk is assumed to cover such costs as have to do with the possible peak load demands on the plant including the distribution system is necessarily much greater in order to care for peak loads, than would be true for uniform, non-fluctuating loads, it has usually been assumed that all charges connected with investment, such as interest charges, are included in this category. A portion of the time of certain executive officers is also thought of as being properly chargeable to this account. Having determined the bulk figure, the distribution to the individual consumers is usually effected by finding the total "capacity" of the individual consumers, on the assumption that the area of the service lines or meters supplying the property is a fair measure of the demand which the consumer may make upon the system. When this individual capacity charge is found, it is usually combined with the "consumer charge" in order to form a "service charge" usually based on the size of meter. In practice, the strict application of the theory is usually considerably modified by the introduction of a more or less arbitrary diversity factor.

The "output charge" covers such costs as fuel, labor of station employees, chemicals, etc., and varies strictly with the quantity of water pumped. The larger the pumpage the lower this unit cost.

There is little dispute as to the fact that these three general classes of costs do apply in a water works plant. The only divergence of opinion would arise as to their derivation and constitution, and as to their equitable distribution in a rate schedule when once determined. It is in the desire to stimulate further discussion of this problem and in the hope that ultimately a more or less standardized method of procedure may be derived and agreed upon that this discussion has been undertaken.

When the foregoing premises are examined, little objection can be suggested to the methods employed in arriving at or in distributing the "consumer" or the "output charge". When the "demand charge" is similarly examined, however, some of the present methods appear open to question on both counts. It may as well be conceded at this point that no hard and fast rule may be employed in the making of the final rate. Considerations other than those dictated by pure theory must often times be consulted in arriving at the final determination. The making of a rate involves judgments of a judicial character. Questions of expediency often modify the rate derived from a disinterested study of the conditions at the plant. However, in the building of the rate it will probably be conceded that reasonable assumptions corresponding as closely as possible to the known conditions of the plant should be employed. There are several premises in the methods used in deriving and distributing the "demand charge" which appear to the writers not to correspond with the ordinary observable conditions of plant operation.

What are these conditions which are common to all plants and are a matter of every day acceptance in their operation? As to the physical aspects they are essentially these. The plant at a given time furnishes an average daily quantity of water which remains fairly constant from year to year. There is, however, a very wide variation in the consumption during any one day, the minimum being at night and the maximum usually about 10:00 a.m. There is also a seasonal variation; the summer demands and the winter peaks usually exceeding considerably the average consumption. Finally, each plant recognizes the possibility of a set of circumstances which may put a very heavy demand on the plant for a brief period. In addition to these considerations there is always the opportunity that the plant may be called upon to supply water for a heavy conflagration.

On the back-of-the-counter side of the water works office there is another factor which can be counted upon with the same degree of certainty as the average annual consumption. This is the assurance, built up during a long association with the conditions of water works practice, that the consumers can be depended upon to continue their use of water, and, consequently, that the money will come over the counter in a fairly uniform stream from year to year, the growth of the population being taken into consideration.

These are well understood characteristics which are common to the personalities of all plants. In the casting of many rates these conditions have not had an opportunity to be reflected, but have been replaced by theoretical assumptions which do not correspond with the facts.

The justification for the service charge, as advanced by its advocates, starts with the idea that the utility must meet certain fixed and administrative charges whether water is delivered to the consumers or not. It is implied, therefore, that there should be a certain stated charge made against each customer over and above the charge for water and which will apply whether any water is used or not. This idea seems to be entirely reasonable, when properly applied, because there are certain investment charges against his specific installation for which the utility should receive adequate return in the rates secured from him, and which conceivably a charge against consumption alone would not always cover. The strict application of the usual theory would build up, however, such a large service charge as to make this portion of the consumer's bill the largest item, in the case of the majority of consumers. This would be true, because in the ordinary case most of the fixed charges are thrown into this item. After the fire protection charge to the City (which is chargeable against this item) is taken out, the amount still levied upon the consumer is high.

The fallacy in this premise, as it appears to the writers, lies in the assumption that the whole of the fixed charges should be placed into the demand classification. This idea neglects the obvious fact that the plant is constructed not only for a large demand but primarily for day to day service to consumers. Furthermore the habits of the consumers are fairly well established and quite constant. The assumption that they as a body will suddenly cease to use water is strictly opposed to the facts. The revenue, however the rate is formed, has the habit of coming into the office with due regularity.

All that the utility can reasonably expect is that a sufficient charge in the form of a service rate be assessed against the consumer as will cover the legitimate costs of investment assessable against him, so that if for some reason, such as absence on vacations, his consumption becomes abnormally low, there will still be enough revenue derived to carry his account.

To point out other apparent defects in the present theory and to suggest possible remedies, it will be necessary to enter into a discussion of some of the details of rate making. Admitting that the element of judgment must enter into the determination of the form of the rate finally adopted, yet it certainly will be desirable to fix limits within which this function may operate. In order to fix the lower limit it will be convenient to inquire as to what would be the minimum investment required for supplying the water to consumers.

It is obvious that the absolute minimum investment would be the one in that plant which would be required to work regularly, uniformly and continuously for 24 hours per day, 365 days per year, delivering the total required quantity, but uniformly and not as at present, as demanded. Such a condition might be conceived if each customer were thought of as having a storage tank which would equalize all of his fluctuations and into which the utility would deliver water at a uniform rate. Obviously the plant investment for this arrangement would be much less than for the plants actually erected, and this condition would extend from the pumps to the filters, buildings and distribution system and would include some reduction even in the size of the consumer's meter and sometimes his service line. This would be the absolute minimum for a plant which would render average day to day service. It is our belief that at least this much of the investment (and probably more) will be required for ordinary service. The utility could not get along with less.

If this be granted and if it is also conceded that the principal reason for the existence of the plant at all is the serving of the daily needs of the consumer **it would seem that this much at least** of the fixed charges on the plant investment **is chargeable directly against the consumption,** since in such a plant the summation of all consumptions (or total annual consumption), when divided into the total fixed charges, would represent the price per unit which, when applied to the consumption of each consumer, would fix the proportion of the whole cost which he should bear. This charge then is strictly proportional to the actual average consumption. Contrary to the usual practice then, it would seem that **this cost should be made a part of the output charge,** which is made on the basis of actual consumption of water.

*Hypothetical Water Company, 50,000 population, apportionment of charges*

| | METER SIZES | | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ⅝ inch | ¾ inch | 1 inch | 1¼ and 1½ inch | 2 inches. | 3 inches | 4 inches | 6 inches | |
| Number of consumers | | 7,750 | 840 | 379 | 69 | 68 | 27 | 17 | 12 | 9,162 |
| Number of meters | | 7,817 | 846 | 383 | 74 | 75 | [redacted] | 20 | 14 | [redacted] |
| Annual consumption—Mil. Gals. | | 414 | 114 | 125 | 54 | 18 | 208 | 248 | 348 | 1,629 |
| Average consumption per meter—gallons | | [redacted] | 135,000 | 327,000 | [redacted] | 1,575,000 | 6,300,000 | [redacted] | 24,900,000 | [redacted] |
| Fixed charge on meters | $13,417 | $10,500 | $154 | $910 | $217 | $343 | $287 | $362 | $64 | $13,417 |
| Ratios: Output 38, demand 134, Fire 0 | | 116/705 | 580/1200 | 1700/2050 | 11/35 | 55/76 | 141/139 | 20/40 | 9/13 | |
| —Distribution to output | | $1,728 | $75 | $755 | $161 | $249 | $207 | 180 | 445 | $3,800 |
| x Distribution to demand | | 8,772 | 79 | 155 | 56 | 94 | 80 | 182 | 199 | 9,617 |
| xRepairs to meters—demand | $16,000 | $12,525 | $183 | $1,085 | $259 | $108 | $342 | $431 | $767 | $16,000 |
| Fixed charge on gridiron | $32,165 | | | | | | | | | |
| Output and demand | | $13,070 | $1,414 | $640 | $116 | $115 | $46 | $29 | $20 | [redacted] |
| —Output | | 6,870 | 832 | 426 | 78 | 77 | 30 | 20 | 14 | 8,347 |
| xDemand | | 6,200 | 582 | 214 | 38 | 38 | 16 | 9 | [redacted] | 7,103 |
| oFire | | | | | | | | | | 1,6715 |
| Fixed—reservoirs and supply lines | $50,590 | | | | | | | | | |
| Output and demand | | $8,990 | $2,470 | $2,710 | $1,175 | $2,560 | $4,510 | [redacted] | $7,545 | $35,340 |
| —Output | | 4,495 | $,370 | [redacted] | [redacted] | 1,830 | [redacted] | 3,850 | 5,380 | 22,675 |
| xDemand | | 4,495 | 1,100 | 1,020 | [redacted] | 730 | 1,290 | 1,530 | 2,165 | 12,665 |
| oFire | | | | | | | | | | 15,250 |
| Fixed—pumping and filters | $57,130 | | | | | | | | | |
| Output and demand | | $13,065 | $3,600 | [redacted] | $1,705 | $3,725 | [redacted] | $7,830 | $10,972 | $51,417 |
| —Output | | [redacted] | 2,400 | [redacted] | 1,310 | 3,100 | 5,480 | [redacted] | 9,140 | 40,100 |
| xDemand | | 3,745 | 1,200 | 1,130 | 395 | 625 | 1,090 | [redacted] | 1,832 | 11,317 |
| oFire | | | | | | | | | | 5,712 |
| xBilling, collecting, etc. | $14,920 | [redacted] | $1,365 | $617 | $120 | $124 | $52 | $32 | $23 | $14,920 |
| —Operating expense | $116,400 | $29,550 | $8,150 | $8,930 | $3,860 | [redacted] | $14,880 | $17,720 | $24,880 | $116,400 |
| Totals:— | | | | | | | | | | |
| oFire | [redacted] | | | | | | | | | |
| xService | $71,622 | $48,327 | [redacted] | $4,221 | $1,203 | $2,016 | [redacted] | $3,484 | $4,992 | $71,622 |
| —Output | $191,322 | 51,963 | 12,827 | 14,021 | 6,249 | [redacted] | 23,817 | 28,300 | 39,859 | 191,322 |
| | [redacted] | $100,290 | [redacted] | [redacted] | $7,452 | [redacted] | $26,687 | [redacted] | $44,851 | $262,944 |
| Average price per m. gals | | 24 2c | 15.2c | 15 1c | 13 8c | 13 3c | 12 8c | 12 8c | 12 8c | 16 1c |
| Service | | $6 18 | $5 33 | $11 00 | $16 30 | $26 90 | $90 00 | $174 00 | $356 | $7 73 |
| Output | | 0 126 | 0 113 | 117 | 0 116 | 0 116 | 9 115 | 0 114 | 0 114 | 0 118 |
| Final rate adopted: | | | | | | | | | | |
| Service | | $6 00 | $8 00 | $10 00 | $13 00 | [redacted] | [redacted] | [redacted] | [redacted] | $7 17 |
| Straight output charge of | | 0 12 | 0 12 | 0 12 | 0 12 | 0 12 | 0 12 | 0 12 | [redacted] | 0 12 |

A good example of a minimum plant, as regards the water supply element in plant investment, would be a gravity supply with a reservoir large enough to supply all deficiencies in stream flow. Any hourly or day-to-day fluctuations in load would affect such a large reservoir not at all. The same reservoir would be required whether the consumptions were uniform or fluctuating and the fixed charges against a storage reservoir would therefore appear entirely in the output charge.

Having now allocated to output charge certain elements of cost, which in the past have been considered as applicable to demand and have been made up into the service charge, there remain certain costs which should admittedly be included under the demand heading. A suggested method of dealing with these costs will now be discussed.

The method proposed is that of splitting up the plant investment into various categories representing like service, such as pumping station and accessories, filtration plant, reservoirs, carrying mains, gridiron distribution system and services and meters. Having accomplished this, the next step involves a study of the probable relation between the normal use and the maximum demand on each element. This may best be illustrated by example. An examination of the pumpage record of the plant is made and the average daily pumpage determined, as is also the maximum hour's pumpage at any time during the year. If a record of pumpage during a heavy fire can be found this also is recorded, or else the maximum pumpage possibilities of the plant used. Assume that the results are as follows: Average daily pumpage rate, 1,000,000 gallons; maximum hourly pumpage rate, 2,000,000 gallons; fire, 2,500,000 gallons; then for convenience the investment costs would be broken up as follows: 1/2.5 to output charge, (2-1)/2.5 to demand charge and (2.5-2)/2.5 to fire protection service. A little consideration of the activities of the average water works plant will indicate that there may be and usually is a wide variation between the demands of the various elements of the plant. These will also vary with the size of the plant, the larger the plant the smaller the variation. The greatest fluctuations will occur the nearer the consumer is approached. The diversity factor or ironing out effect becomes more pronounced the nearer to the source of supply. It is practically impossible and really unnecessary to determine the actual demand of each consumer, but it will be sufficiently accurate to consider the different classes of consumers based on the size of their meters. As a measure of the demands of various consumers we have employed the study of this subject as made by the committee on meter rates for the New England Water Works Association which appears in the December issue of the 1916 A. W. W. A Journal. The entire fixed charges on all meters is first allocated to the various groups of meters and the amount to output and to demand fixed by reference to the relation between average use and maximum demand. It is assumed for convenience that the investment in an "average" meter and the actual meter in use (which is large enough to supply the maximum demand) will be proportional to the demands in each case. The cost of repairs to meters probably bears a close relationship to the investment in meters and this cost is distributed between the classes of meters in proportion to the investment.

A fair basis for distributing the costs of the gridiron system is next sought. It is believed that the fairest basis is that found by assigning the costs directly on the basis of total number of customers. A more or less arbitrary distinction must be made between carrying mains and gridiron system, the former representing in this discussion the large arteries emanating from the plant which carry water out to distant districts and to which the smaller mains connect to distribute the water to the consumers themselves.

The size of the gridiron lines is largely dictated by friction loss considerations, it being necessary for the lines to be large enough to furnish fire streams without undue pressure loss. The mileage in these mains has little reference to actual or relative consumptions, but they are made necessary by the fact that the population lives in homes that are scattered over a wide area, and by whose properties water lines must be laid in order to render service. The investment in these lines varies more nearly with the population than with consumption, as such, and it seems fair then to consider that the investment in gridiron system is the same for each consumer. That it probably does not vary with consumption directly might be seen if it were assumed that in a given plant one large industrial consumer, located near the plant, used as much waer as all of the remaining population, yet this fact would make little difference in the mileage of mains; they would be required in any event in order to supply the remaining consumers. Any increase in consumers involving building up of new territory would require proportionately greater mileage.

In the distribution of this burden the fire protection charge would ordinarily take the largest share of

*Small Water Company, 3,500 population, apportionment of charges*

| | | METER SIZES | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|
| | | ⅝ inch | ¾ inch | 1 inch | 1¼ inch and 1½ inch | 2 inches | 4 inches | |
| Number of consumers and meters | | 626 | 4 | 9 | 3 | 2 | 1 | 645 |
| Annual consumption—gallons | | 14,553,600 | [illegible] | 7,194,400 | 1,957,600 | [illegible] | [illegible] | [illegible] |
| Average consumption per meter—gallons | | 23,250 | 127,200 | 800,000 | 652,500 | 2,943,600 | 6,871,600 | 57,300 |
| Fixed charge on meters, etc. | $1,829 | $1,711 | $17 | $36 | $23 | $17 | $25 | [illegible] |
| Ratios—Output 19, Demand 100, Fire 0 | | 116/705 | 580/1200 | [illegible] | 11/35 | 55/76 | [illegible] | [illegible] |
| —Distribution to output | | $282 | [illegible] | $30 | $7 | $12 | [illegible] | $352 |
| x Distribution to demand | | [illegible] | [illegible] | 6 | 16 | 5 | 12 | 1,477 |
| xRepairs to meters, etc. (demand) | $328 | [illegible] | [illegible] | $6 | $4 | $3 | [illegible] | $328 |
| Fixed charge on gridiron | $5,363 | | | | | | | |
| Output and demand | | 2,705 | $17 | $40 | $13 | $9 | $4 | [illegible] |
| —Output | | 1,420 | 10 | 27 | 8 | 6 | 2 | 1,473 |
| xDemand | | 1,285 | 7 | 13 | 5 | 3 | 2 | 1,315 |
| oFire | | | | | | | | 2,575 |
| Fixed—on standpipe, force and carrying | $3,850 | | | | | | | |
| Output and demand | | $1,062 | $37 | [illegible] | [illegible] | $428 | $502 | $2,695 |
| —Output | | 483 | 19 | [illegible] | 89 | 285 | [illegible] | 1,525 |
| xDemand | | [illegible] | [illegible] | [illegible] | [illegible] | 143 | 144 | 1,170 |
| oFire | | | | | | | | 1,155 |
| Fixed—on pumping plant and filters | $8,839 | | | | | | | [illegible] |
| Output and demand | | $2,608 | $92 | $1,290 | $351 | $1,057 | $1,232 | [illegible] |
| —Output | | 1,630 | [illegible] | 862 | [illegible] | [illegible] | 880 | 4,419 |
| xDemand | | 978 | [illegible] | 428 | 117 | 302 | 352 | 2,211 |
| oFire | | | | | | | | 2,210 |
| xBilling, collecting, etc. | $2,047 | [illegible] | $13 | $29 | $10 | $6 | $3 | $2,047 |
| xAdministration, etc. | 3,000 | 1,763 | 35 | [illegible] | 112 | [illegible] | 372 | [illegible] |
| —Operating Expense | $9,399 | $8,905 | $137 | $1,935 | $527 | [illegible] | $1,850 | [illegible] |
| oFire | [illegible] | | | | | | | [illegible] |
| xDemand service | 11,548 | [illegible] | [illegible] | $1,113 | [illegible] | $781 | [illegible] | 11,548 |
| —Output | 17,708 | 7,720 | [illegible] | 3,145 | 865 | 2,643 | 3,103 | 17,708 |
| | $35,196 | 16,047 | [illegible] | [illegible] | $1,483 | $3,424 | [illegible] | $35,196 |
| Average cost per M. gallons | | $1.10 | $.69 | $.59 | [illegible] | $ 58 | $ 58 | $ 95 |
| Service charge | | [illegible] | [illegible] | $123 80 | $106 90 | $390.00 | [illegible] | $17 90 |
| Output | | [illegible] | 0.46 | 0.44 | 0.44 | 0 45 | 0.45 | 0 48 |
| Final rate = 4000 per quarter at 55 cents | | | | | | | | |
| All over at 45 cents plus service charge of | | [illegible] | $35.00 | [illegible] | [illegible] | $360.00 | [illegible] | |

the cost, and the distribution of the remaining costs between "output" and "demand" would be made with reference to actually observed demands on various parts of the system where records were available. The further distribution between individual classes of consumers would have to be a question of judgment, but the limits would probably be fairly well defined. The tabulation at the end of this paper, in which a complete example is worked out, will explain the method in greater detail. The ratios for each division having been obtained by observation of actual conditions for this plant, these changes are distributed among the different classes of consumers by methods similar to that for meters.

The consumptions of the various classes of consumers are probably the best basis upon which to distribute the fixed charges on carrying mains, after a figure has been arrived at for charge to fire protection. In a majority of cities the consumption, both large and small, may be distributed at various, widely scattered locations throughout the city. The carrying mains must be large enough to supply these maximum collective demands or consumptions.

Since the quantity of water to be delivered at various controlling areas, not necessarily influenced by distance alone, is the basis for the design of the carrying mains, it would appear that the money that went into its construction would bear a closer relation to the consumption than to any other feature. The ratio between the average daily use and the maximum demand becomes less as the source of supply is approached, and the ratios in the carrying mains are less than in the gridiron.

The consumption basis for the distribution of costs has been used in each of the remaining classes of service with the exception of "consumer costs," where such items as book-keeping, billing, reading meters, etc., have been distributed directly in proportion to the total number of consumers, and the result carried into the sum which later forms the "service charge."

Having assembled the "demand" and "output" charges for all consumers on the same sized meters the average output charge is found by dividing the total output costs by the total annual consumption for that class, and the "service charge" by dividing the corresponding sum by the total number of consumers in that class. It then becomes a relatively simple matter to work out an output curve which will substantially fit the average output figures shown in the computed results.

It is intended that such an analysis as here proposed should serve as a cost study preliminary to the administrative decision or the adjudication resulting in the final rate schedule. A concrete illustration of the method discussed will be found in the following tabulations: In the first, the conditions are similar to those which are to be found in a plant serving a population of approximately 50,000 people, while in the second a population of approximately 3500 is considered.

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## "Heating the Home"

The Dominion Radiator Co. have issued an interesting booklet entitled "Heating the Home." A quantity of useful information is contained, with excellent illustrations.

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# Steam Shovel Digs for Drag

## Breaks up Hard, Stiff Material in Sewer Excavation and Loads on Bench for Bucket to Pick up

A dragline bucket would not dig into the hard yellow and blue clay, through which a sewer excavation was being made by the Gass-Thurston Co., of Detroit Michigan. So they placed their Type "B" Erie steam shovel down in the hole to break the clay, loading up to the dragline. This 20-ton shovel—weighing about 25 tons with its caterpillar type mounting—was picked up by a large locomotive crane and set right down in the cut.

The sewer cut is 16 ft. wide, and varies in depth from 24 to 27 ft. The shovel loads out the material on a bench straight ahead, 15 ft. above the bottom of the cut. The dragline machine then swings its bucket into the bench and removes the loose material, as shown by the photos.

Steam shovel working in deep sewer excavation.

Working in this way, an average output of 350 cu. yds. per day has been maintained, with about 400 cu. yds. as the best day's work. The speed of the dragline governs the output—as Mr. E. J. Gass, of the Gass-Thurston Company writes: "The output of the Erie shovel is governed by the speed of the dragline. If it were loading out the excavated material direct, its output would be considerably greater."

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## Tenders for Bridge Lower than Estimate

Tenders for the construction of the new Sherbrooke Street East bridge over the Canadian Pacific tracks at Hochelaga, Montreal, P. Q., were opened by the Administrative Commission recently. Three hundred thousand dollars was voted for this work, and while the tenders are in all cases substantially below this mark, there may be some additional work in the way of driveways to be done.

The tenders are as follows: Arthur Leduc, $144,100; Alphonse Gratton, $153,889.50; Atlas Construction Company, $155,050; Kennedy Construction Co., $157,205; Foundation Company Limited, $157,765; John Quinlan & Co., $149,983; J. Levasseur, $161,971.20; Archambault-Leclair Limited, $162,600; J. A. Grant & Co., Limited, $164,653; Anglin-Norcross, Limited, $172,075; B. Brault, $178,930; A. F. Byers & Co., Limited, $188,890; L. A. Ott & Co., $192,815.88; Phoenix Bridge Co., $56,474, (steel only.)

## CONVEYOR USED IN PLACING CONCRETE

The construction of the mast foundations at the Tuckerton station of the Radio Corporation of America presented a difficult situation which was overcome by the use of light, mobile, equipment. The station is situated on the Jersey Meadows about six miles from Tuckerton and was originally built for the German Government. Since coming into possession of the Radio Corporation of America after the war a decision was reached to increase its capacity, and a contract was accordingly awarded to the J. G. White Engineering Corporation of New York City to erect six steel masts, each 305 ft. high.

The foundations for these masts were excavated in swampy material, which necessitated sinking coffer dams to a depth of 8 to 10 feet for each of the six masts and twenty-four anchorages. On account of the poor bearing quality of the soil it was found necessary to drive piling in each coffer dam.

As the ground was not able to sustain heavy equipment, it was deemed expedient to design a special rig for driving these piles. This was accomplished by equipping a light pile driver with a gasoline hoist and supplementing it with gasoline-operated jetting equipment of sufficient power to insure penetration to the desired depth.

This same situation presented a problem in concreting the foundations and in distributing sand, gravel, cement and lumber, as well as steel for the masts. A unit consisting of one mast and four anchorages required approximately 250 yards of concrete, making an average of 50 cubic yards for each individual pour.

After a careful study of the situation there was employed for material distribution two small tractors especially equipped with an extension to the traction wheel to afford as wide a bearing as possible. Each tractor was coupled to an ordinary light gravel wagon of the stick-box type equipped with extra wide tires. These were able to travel on the meadows in any direction and operated in a most economical manner.

The design of the foundations made it necessary for them to extend above the ground from 8 to 10 ft. To pour this concrete it was decided to use one-batch mixers operating in conjunction with 30-ft. portable belt conveyors. This equipment, illustrated in the attached photograph, is light and can be easily and quickly moved. The conveyors proved entirely satisfactory for raising the concrete to the necessary elevation that would permit of a distribution by chutes into the forms. The concrete was admitted to the conveyor through a wooden hopper having an opening directly over the belt which allowed a discharge without scattering the material and a delivery without waste. It was found necessary to place a wiper made of belting or rope on the top of the chute under the conveyor in order to keep the belt clean.

This layout, described in Successful Methods, is operating efficiently and is particularly well adapted for the work at hand.

## DEVICE FOR CUTTING ASPHALT PAVEMENT

An attachment which can be put on any ordinary work car has been devised by the Market Street Railway of San Francisco for making a cut 1½ in. deep in asphalt pavement along the track.

The cut can be made as the car moves along at a rate of 4 to 5 miles per hour. In addition to the saving in cost, a great advantage claimed by this device is its speed of operation. The cut is made by a tool which projects downward from a shoe carried by a work car and set to ride on the pavement at 18 in. or 24 in. from the rail head. The framework supporting the shoe consists of struts attached to the car at three points by means of pins and suitable mountings on the car body. The framework supporting the shoe can be attached to the mountings in about 15 minutes. Once fastened in place, hinged joints make it possible to swing the device up out of the way under the car body, where it is held by hooks until the car arrives at the point where the work is to be done. The apparatus is so arranged that it can be used not only while the car is moving ahead in the usual direction of traffic, but also in the reverse direction by turning the apparatus around. This operation requires only about ten minutes.

When ready to begin cutting it is only necessary to unhook the framework and swing it down so the shoe rests on the pavement. In this position the strut which thrusts the cutting tool down into the pavement is not yet vertical, nor does it carry any weight. When the car moves forward a few inches, however, the hinge in the strut opens still wider, the strut takes a vertical position and, as it tilts the car body 2 or 3 in. out of plumb, takes a considerable weight off the car springs and the cutting tool sinks into the asphalt. The car can then move forward, leaving a clean cut in the pavement. The depth of the cut can be adjusted by changing the bolts which attach the tool to the shoe; the usual depth is 1½ in. and the width ¾ in.

When cutting pavement in very cold winter weather it is sometimes necessary to put a load on the car to prevent the cutting tool from "riding" on the pavement surface. It was found that the best cutting tools were those forged from old carbon steel gads. These were superior to high-speed steel. The tool becomes dulled and requires to be replaced after cutting about 600 ft. in the summer time or 300 to 400 ft. in the winter time.

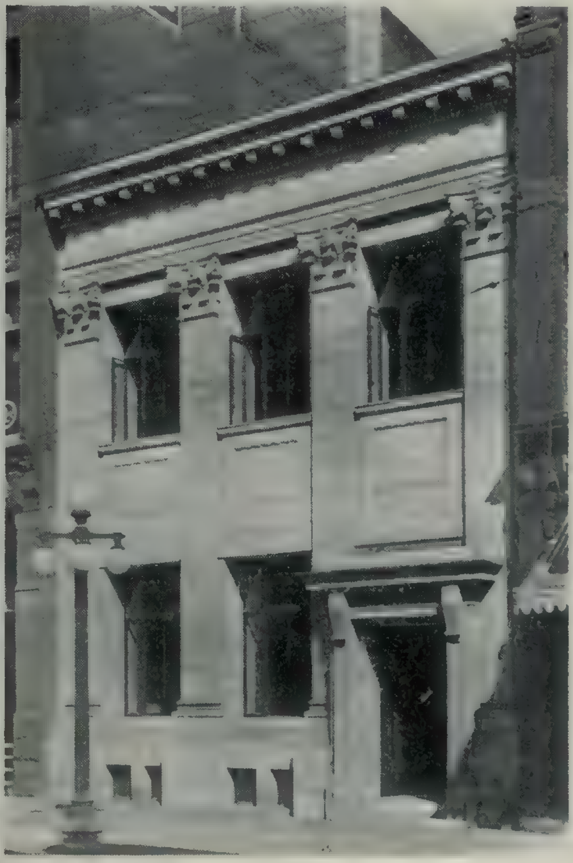
The design of the cutter was worked out by W. D. Chamberlin, principal assistant engineer. B. P. Legare is engineer of maintenance of way.

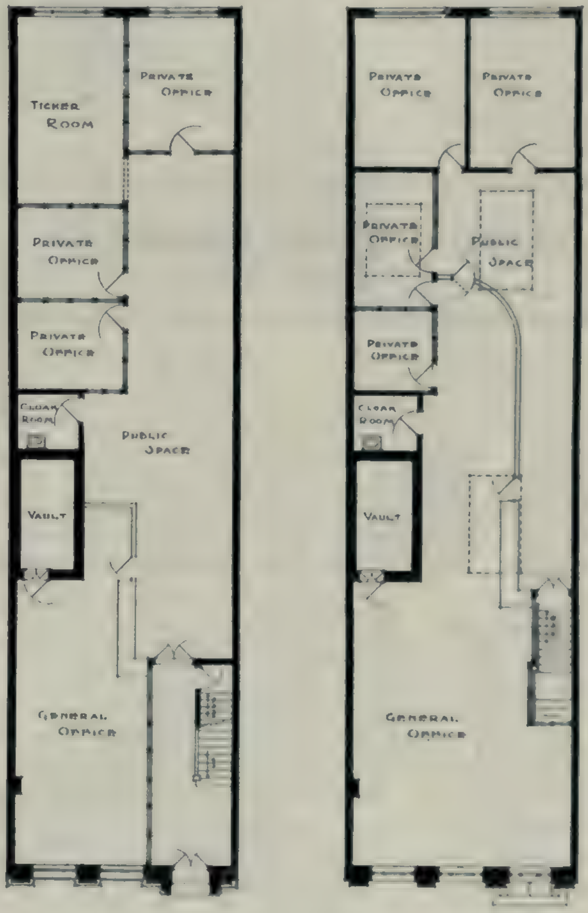
## Montreal Home Builders Co.

The Montreal Home-Builders Company (to be incorporated) have opened permanent offices at 204 St. Catherine Street, West, Montreal, where those desirous of having samples of building materials and accessories, exhibited in the show-room can arrange for a limited space by applying at the above address.

# *Small Office Building of Pleasing Proportions and Design*

The photograph and floor plans reproduced herewith illustrate a small but complete office building erected last year for Messrs. Brouse, Mitchell & Co., stock brokers, 75 Bay St., Toronto. The building is of heavy construction with a front of Indiana limestone. Marble is used for the floors and wall linings in the hall and for the treads of the iron stairways. The floors are of pine, covered with battleship linoleum, while the interior finish is of mahoganized birch. The window frames are metal, fitted with plate glass. Marble lined lavatories are provided in the basement which also contains the steam heating plant. This building was completed, ready for occupation, in less than seven months from the time of commencement, the work being carried out from the designs of and under the superintendence of Mr. F. S. Baker, F. R. I. B. A., architect, Toronto, by Messrs. Norman McLeod, Ltd., general contractors. Other contractors on this work were: McGregor & McIntyre, Ltd., steel and iron; Steel & Radiation, Ltd., metal sash; Marble & Tiles, Ltd., marble and tile; R. Jordan, plumbing and heating; R. A. L. Gray & Co., electric wiring and fixtures; Aikenhead Hardware Co., hardware; Feather & Roadhouse, roofing, skylights, etc.; A. Weller & Co., interior woodwork; Geo. Oakley & Son, cut stone and carving; Murray-Kay Co., Ltd., painting and decorating; T. Eaton Co., Ltd., linoleum; Consolidated Plate Glass Co., glass; Ramsay Contracting Co., reinforced concrete.





First Floor Plan Second Floor Plan

Scale ⅛ Inch = 1 Foot

### The Annual Financial Review

The Annual Financial Review, covering the financial features of Canadian corporations and other corporations in which Canadians are especially interested, for the year ending 1921, has just been issued by Houston's Standard Publications, Toronto Stock Exchange Building, 84 Bay St., Toronto. This is a most valuable compilation of information concerning the earnings, assets and, in general, the stability of the various industries listed. In these days, when there are so many "wild cat" propositions presented in glowing terms to the unwary investor, it is well that there should be available a book of this nature, giving definite, complete and accurate information about our more reliable investments.

Whatever business a man may be in, if he is conservative and successful, he does not trust all his eggs in the one basket; in other words, he finds it a wise policy to invest a certain amount of his earnings in the securities of business propositions other than his own. This is the law of averaging, which, in the main, is the safest course. For this reason, every business man is interested in investments and it naturally follows that every business man should be also interested in this annual Financial Review.

The list of operations covered is very complete and includes the war loans; insurance companies; banks; guarantee companies; our industrials; land, loan, mortgage and savings companies; light and power companies; mining; navigation; steam railways; electric railways; trust companies; telegraph, telephone and cable companies; and miscellaneous. This year the volume runs into almost 800 pages. The price is $10.00—a small amount if it represents the difference between safe and hazardous investment of hard earned savings.

## Mainly Constructional

**East and West—From Coast to Coast**

The Dominion Textile Co. last Monday reduced the wages of 5,000 employees by 15 per cent.

The ratepayers of the city of London, Ont., will shortly vote on a by-law authorizing the expenditure of $150,000 on the construction of a dam.

Mr. George Turnbull, chairman of the Public Utilities Commission, of Galt, Ont., recently officiated at the laying of the corner stone of Galt's new $200,000 public utilities building.

The Commissioner of Finance, at St. John, N. B., has been authorized to issue municipal bonds to the value of $820,900, bearing interest at 6 per cent., to pay for civic construction work already completed.

The Town Planning Commission at Oshawa, Ont., recently passed a resolution that building permits will not be issued on lots less than 45 feet frontage, claiming that houses on narrower lots are unsanitary.

The formal opening of the Brantford-Hamilton Ontario provincial highway will take place toward the end of the present month. Several officials of the Highways Department have promised to be present to officiate at the opening.

Durant Motors, Limited, who recently established a plant at Leaside, near Toronto, are considering the establishment of another Canadian plant at Montreal, for the manufacture of cars for export trade. This projected plant would employ, it is estimated, 2,000 men.

The firms of Angus & Taylor and McAuslan & Anderson, of North Bay, Ont., have amalgamated under the name of Angus & Taylor, Limited, and will carry on the business of general contractors, architects and engineers, with head office at the above point. The new firm is capitalized at $250,000.

A ten-storey addition to the Crawford House, at Windsor, Ont., is proposed. Messrs. Penning & Boyde, local architects, have prepared plans for the addition, which will be 100×90 ft., contain 112 guest rooms, each equipped with bath and will cost about $400,000. The plans show a spacious dining room on the tenth floor, with roof garden above.

A recent announcement states a new firm has been organized at Winnipeg, known as Alsip Brick, Tile & Lumber Company. This company will specialize on hollow tile, which will be manufactured at a new plant at Elmwood, Man. This is the first venture in the manufacture of hollow tile in this district, and the manufacturers claim this product is equal in quality to the best imported tile.

The final decision of the Ontario Government not to enter the cement manufacturing industry, provided prices are kept at a reasonable figure, has resulted in the conclusion to go ahead with the organization of a large new cement industry at Owen Sound. American capital is said to be behind this proposed new plant, which will have a capacity of about 4,000 barrels of cement a day.

The city of Edmonton, Alta., has been very active in house construction this year. A recent report states that over two hundred residences, representing an average value of about $4,000, have been erected, besides a number of smaller dwellings and house extensions. The construction season is by no means at an end yet and it is expected a goodly number of houses will be added to the above total, before the end of the season.

### Personal

Mr. Norman R. Wilson, superintendent of the Water Works Department, at Brantford, Ont., will succeed Mr. R. C. Harris as trustee of the Canadian Section of the American Water Works Association.

Mr. George L. Sawyer, formerly sales manager of material-handling machinery for the Barber-Greene Company, Aurora, Ill., has been appointed to represent the Universal Crane Company in the New York field. His offices will be located at Allied Machinery Center, 141 Center St., New York.

The following officers were recently elected by the Ontario Fire Prevention League: Honorary president, Hon. E. C. Drury; president, Arthur Hewitt, Toronto; vice-presidents, J. M. Watt, London, and G. C. Martin, Hamilton; director, class of 1923, Chief James Armstrong, Kingston, and J. J. Stewart, Brampton; directors, class of 1924, John B. Laidlaw, Toronto, and F. L. Mason, Oshawa.

Mr. Wilfrid E. Hobbs has been appointed Comptroller of Town Planning, of Manitoba, with complete control over the administration of the Town Planning Act in this province. This act has been on the books of the province since 1916, but there has been very little development up to the present. This appointment, however would indicate increased activity along this line. Mr. Hobbs has been connected with the Provincial Good Roads department, as engineer.

Mr. A. E. Foreman, district engineer of the Portland Cement Association, at Vancouver, and former chief engineer of public works for the province of British Columbia, was a visitor last week at the offices of the Contract Record. He states that there is no reason to be pessimistic about conditions in the West. Construction is bound to open up although just at the moment unemployment is rather serious. Mr. Foreman came East to attend a re-union of McGill University graduates, he having been a member of the class of '03 in Engineering.

Mr. A. C. Fellows, who, as reported in last week's Contract Record--and, by the way, incorrectly reported as H. E. Fellows--resigned his position as Assistant Chief Engineer of the Quebec Harbor Commission, to accept an appointment to supervise certain large construction work in British East Africa, was made the recipient of a handsome club bag from the employees and officials of the Commission, on leaving. Mr. St. George Boswell, chief engineer of the Commission made the presentation and expressed the regret of the entire staff at losing Mr. Fellows and also wished him success in his new undertaking.

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## *"Forward to Normalcy"*

"Back to Normalcy" has been, this last year or so, the battle cry of the world. How often this injunction has been sounded by the economist, the politician, the business man or the common citizen, the implication in the slogan being the re-attainment of pre-war price and production conditions. "Normalcy" has been the synonym for the price level of 1914, this being regarded, seemingly, as the logical goal towards which to strive in these days of reconstruction. A somewhat different note, however, is struck in an article, entitled "Forward to Normalcy", by W. A. Babbitt, in one of our contemporary business papers. This author takes hold of the present economic situation energetically and attempts to prove the fallacy of the attitude which has so satiated public thought at the present time and which is summed up in the plea "back to normalcy".

Mr. Babbitt's whole argument is designed to establish that "normalcy to which business must attain or perish is not behind us, but ahead of us. It will have to rest on a new series of economic conditions of which 1914 knew nothing." Mr. Babbitt claims that the slogan "back to pre-war prices" sets up a goal of which only a fool or lunatic could approve and which no man, sane or insane, did approve in 1914. "What went with normalcy in 1914 price levels?" he asks. "Universal stagnation of business—general unemployment—one great financial crash after another. . What particular item of the economic history of 1914 appeals to you, outside of the low tax rate?" This leads to his conclusion that "normalcy of 1914 is something that we cannot have and that will ruin industry completely if it returns." "How about 1914 price levels?" is Mr. Babbitt's next question, and he answers, "If 1914 price levels were normal, then those of 1913 were not, according to the theory of the price bolsheviki, because 1913 prices were higher than 1914 prices. But 1914 price levels were not normal, nor those of 1913, because these price levels did not make sufficient returns to permit Industry to function. In fact to a less degree but of the same kind, the story of 1914 is the story of 1920-21."

The present tendency to follow the cry "back to normalcy" is due, according to Mr. Babbitt, to mob psychology, which rallied around this slogan with a vengeance. The public was egged on by the touting of the cry from every possible angle of fact and fancy. They accepted the slogan and stopped buying. Though they had forgotten the hard times they went through with 1914 prices, they remembered the prices, which looked very good on the basis of 1920 wages. "A boom period," states this analyst, "was marked by sub-normal production, measured by volume. Measured in dollars, it was enormous. It was an orgy of dollar spending, not an orgy of absorbing commodities. It was a debauch of profiteering, an insane hocus-pocus of reckless buying and reckless cancellation. The buying nerve of the public was paralysed.

In referring to the relentless policy of buyers of continuously hounding for lower prices, Mr. Babbitt demonstrates by a chart that the total "realization-from-sales" line dropped below the "total-cost" line and has stayed there ever since, indicating an average loss for all business done for the above period to date of over 15 per cent. of the total cost. This loss does not include losses due to inventory write-off.

"What has been the result of this?" asks Mr. Babbitt, and he answers, "that instead of business which we wanted, all we have is wreckage; that the farther back we go to normalcy, the farther we get into the slough of despond." In suggesting a remedy for these pitiful circumstances, this commentator attempts to derive a true definition of "normalcy", which he characterizes as the balanced condition of supply and demand, relative to the current economic situation. "The proof or index of 'normalcy' is a price level which encourages bona fide traffic in commodities." Mr. Babbitt's plan for attaining this viewpoint is to make every effort to re-establish in the public mind a sound faith in the necessity and justice of price levels related to our current economic condition. He points out that there are many new factors in the present economic situation as compared with 1914 that will prevent our ever reaching again the conditions that had been established in pre-war years and that in view of this, our energies should be directed toward the new and true normalcy which is ahead and not behind.

The "forward to normalcy" policy suggested by Mr. Babbitt, is not without its virtues and while there are students of economics who may have views entirely the antithesis of those given above, Mr. Babbitt's are at least worthy of some consideration and his analyses on present conditions are worth while commenting upon.

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The Department of the Interior, Ottawa, have issued Bulletin 44, entitled "Standardization of Measures of Length at the Laboratory of the Dominion Lands Surveys."

*No. 67*

# *Canada's Engineers—E. E. S. Mattice*

Mr. Edward Ernest Stuart Mattice, general manager of the Phoenix Bridge and Iron Works, Ltd., Montreal, and formerly general contracting engineer of the Dominion Bridge Company, Montreal, whose professional career the Contract Record takes pleasure in presenting in this series, has had a very wide and varied experience in structural engineering, largely with the Dominion Bridge Company, Limited, and with whom he began 20 years ago as a draftsman. Mr. Mattice, after passing through Upper Canada College, Toronto, was technically educated at McGill University from which he graduated with honors in Applied Science in 1890, at the age of only 20 years. He forthwith joined the Dominion Bridge Company, as draftsman, later becoming a transit man for the Dominion Government, on the Cornwall Canal and draftsman for the Norton Iron Works, Boston. In 1894 he re-joined the Dominion Bridge Company in his former capacity, a year later becoming their Montreal representative, which position he occupied until 1910. At that time he joined the Lewiston Land & Water Company, Lewiston, Idaho, as assistant engineer, but went back to the Dominion Bridge Company a year later as constructing engineer, becoming general contracting engineer in 1917.

In his positions of constantly increasing responsibility, Mr. Mattice has been very closely identified with the design and construction of some of the largest structural steel buildings in the country. A list of all the individual projects with which he has been connected would be too lengthy for publication, but the scope of his activities might be, to some degree, indicated by the following list of structures which have been handled by him in his capacity of contracting engineer for the Dominion Bridge Co.: Montreal Harbor Sheds, Montreal; Transcontinental Railway Shops, at Quebec; Eastern Township Bank Building, Montreal; head office of the bank of Montreal, Montreal; Windsor Hotel, Montreal; Windsor Station, Montreal; C. P. R. Office Building and King Edward Hotel, Toronto; Fort Garry Station, Winnipeg; Chateau Laurier, Central Station and new Parliament Buildings, Ottawa, etc. These are but a few of the many important buildings with which Mr. Mattice has been closely connected. Nearly every type, including public buildings, industrial buildings, schools, telephone exchanges and special structures have been supervised by him, as far as the structural steel work was concerned.

Mr. E. E. S. Mattice

Mr. Mattice's interests extend beyond his connection with the Dominion Bridge Company, as is evidenced by his position as director of the Eastern Canada Steel & Iron Works, Ltd., and president of the Structural Engineering Co. Ltd., a firm which he organized in 1912.

Mr. Mattice is a member of the Engineering Institute of Canada, as well as of other clubs including the Engineers, of Montreal, St. James, of Montreal and the National, of Toronto.

## Structural Steel Association Undertake Educative Campaign

The Structural Steel Association has just issued an attractive four-page folder as part of its comprehenive educational campaign, incorporated to acquaint possible builders with the advantages of structural steel construction. The text of the present leaflet is "Structural Steel—the Backbone of Speed in Construction" and the message is made effective by the reproduction of a series of photographs of the new King Edward Hotel, Toronto, showing the erection of the steel framework of this 18-storey building, in only 92 working days.

The Structural Steel Association is not a commercial body but an organization with an educative policy solely. In this connection it issues literature of an instructive nature, such as the pamphlet referred to above, and other folders and cards which contain specialized information of practical use to engineers, contractors and architects.

## Cement Standards

In our issue of Oct. 5, page 883, under the heading "Useful Data" two of the items referring particularly to portland cement, are applicable, as we quoted them, to the United States but not to Canada. In the United States the standard barrel of portland cement weighs 376 lbs.; in Canada it is 350 lbs. In the United States a bag of cement weighs 94 lbs., but in Canada only 87½ lbs. In both countries, however, a sack is usually considered as containing a cubic foot.

## Sewage Disposal for Peterborough

The proposed new Imhoff sewage disposal system for the city of Peterborough, Ont., will cost, it is estimated by city engineer Parsons, $320,100. This system will handle 6,000,000 imperial gallons of sewage per day. The plans of the new plant have been sent to the Provincial Board of Health for approval.

# Sewer Construction in Swamp Land in Vancouver, B.C.

## A Description of an Unusual Piece of Drainage Work in Muskeg Soil—Character of the Ground Made Excavating Difficult and Settlement Proved Troublesome—Concrete Disintegration

A. G. DALZELL, M.E.I.C.

Those who are engaged either on the design or construction of sewers have often to contend with a very uncertain factor—the character of the sub-soil. In certain geological formations, even borings or test pits may be deceptive. In one instance, before calling for tenders on a unit price basis for a large trunk sewer the writer had test pits opened and one in the centre of the work showed good sharp dry sand. On this evidence one contractor submitted a price for a specified amount of rock excavation at 10 cents a cubic yard and increased the price of ordinary excavation much above the average. This tender was not the lowest, and even if it had been, would not have been recommended for acceptance as being contrary to the spirit of a unit price contract. If, however, it had been accepted the contractor would have been most unfortunate in his gamble, because it turned out that this test pit chanced to be located on a sand pocket not 30 feet long. The amount of rock excavation thus greatly exceeded the amount estimated.

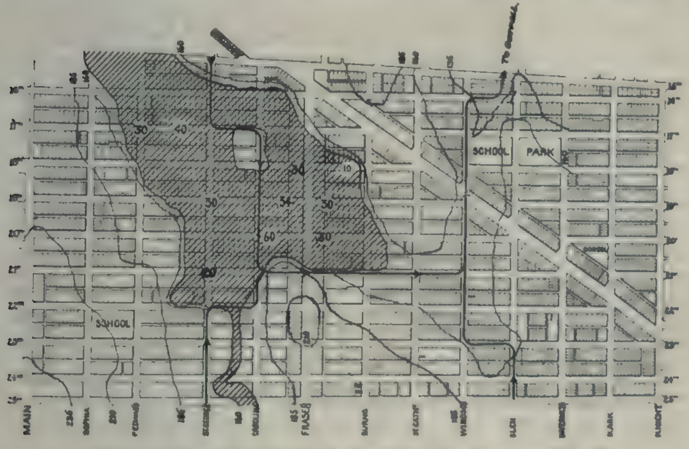

Fig. 1—Map of Ward 8 district, Vancouver, B. C.

Experience gained in dealing with excavation and construction in soils of different character is, of course, of great value. The benefits of that experience can only be conveyed in a very limited way through writing, but occasionally a record of a failure or an error of judgment may save someone else making the same mistake. As engineers cannot claim to be infallible, there ought to be no hesitancy in admitting that if the opportunity occurred of doing similar work over again other methods would be followed.

With this idea in mind, the experience of the writer in the construction of sewers in swamp land is submitted. A similar experience may perhaps not come in the way of many, but the unexpected sometimes happens.

Though the work was done some five years ago, it is only very recently that the investigations of other engineers and chemists, as hereinafter recorded, has substantiated theories entertained whilst engaged on the work. These investigations show that in concrete construction in land of this character most careful attention must be paid to the drainage and the removal of contaminated water.

The work hereinafter described was carried out in the city of Vancouver, B.C. The city and the adjacent municipalities of South Vancouver and Point Grey are situated on the Burrard peninsula, which lies between Burrard Inlet on the north and the north arm of the Fraser River on the south. A continuous east and west ridge, with an elevation of 300 to 400 feet above sea level, runs along the centre of this peninsula. The city of Vancouver lies on the northern slope. The solid rocks of the peninsula are almost everywhere covered with glacial drift, though not to any great depth, as a rule. The drift deposits have interfered in many cases with the original stream system of the peninsula. One of the most noteworthy instances of the kind is found in the area which forms Ward 8 of the city of Vancouver.

### Reclaimed Swamp Land

A level tract of land, with a very irregular boundary which coincides pretty nearly with the contour line of 160 feet above mean sea level, occupies the middle of the western half of the Ward. This was evidently a lake at one time, which had its origin in the dumping of glacial drift across the course of two streams that flowed down the northern slope of the Burrard peninsula from the uplands of South Vancouver. The sur-

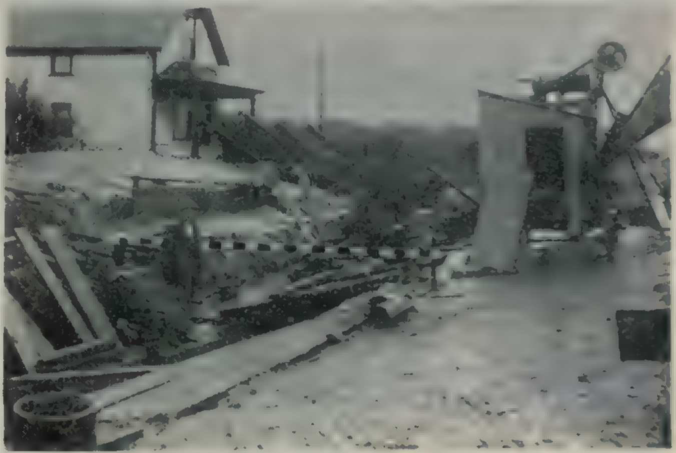

Fig. 2—Trench for 42-inch sewer, 18 ft. deep. Spoil from muskeg bog caused shrinkage on the surface of over 4 ft. on one side and 15 in. on the other. Horizontal rail is at level of original ground.

plus waters of the lake overflowed the northern obstruction and made their way to False Creek, an arm of the sea which cuts into the Burrard peninsula about half a mile to the north. The lake itself was gradually filled up and converted into a muskeg by the accumulation of silt and vegetable matter. The swamp dried up sufficiently to allow of the area being cleared and subdivided into building lots.

Ward 8 of the city of Vancouver in which, as has been mentioned, this reclaimed swamp is situated, is one of the two areas which were formerly under the control of the provincial government, but which were transferred by it to the city in 1911. The ward which coincides closely with the official District Lot No. 301 has an area of 415 acres. It joins the city along its northern boundary, but is surrounded by the municipality of South Vancouver on the other three sides. The principal reason for the placing of D.L. 301 within the city limits was the urgent necessity for water supply and sewer accommodation. Wells had been sunk in the area outside the peat bog, but the water of the bog itself was quite unfit for drinking.

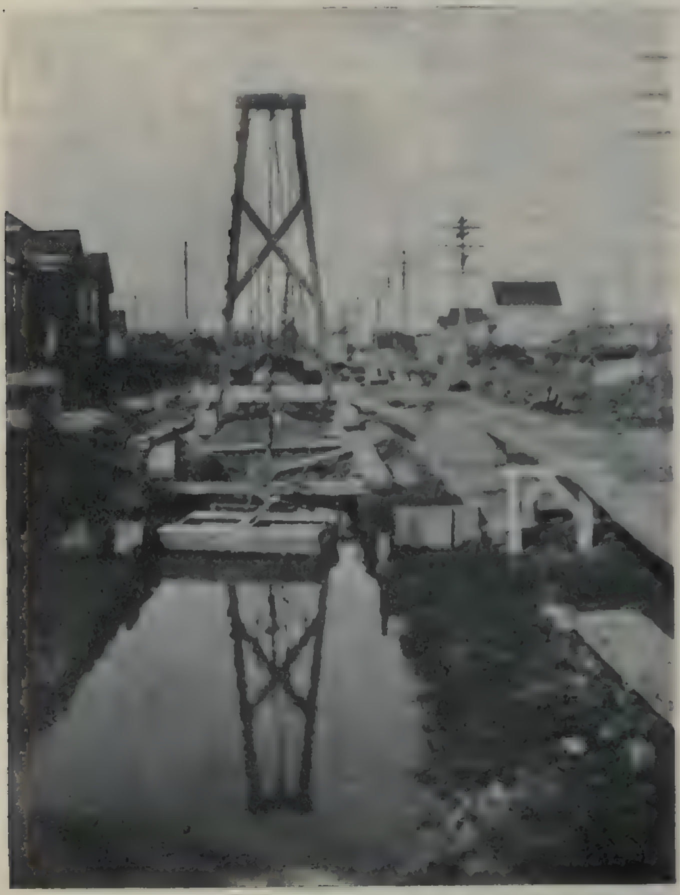
Fig. 3—Water carried on newly placed backfill in muskeg excavation.

When surveys were made for a sewer system it was found that this reclaimed swamp covered an area of about eighty acres (Fig. 1), and that no foundation within its limits could be relied upon to carry even a pipe sewer.

The trunk sewer for the district and the adjacent portion of South Vancouver municipality was planned under the direction of a Sewerage Board appointed by the provincial government, and known as the Vancouver and Districts Joint Sewerage and Drainage Board.

It was found that the main branch of the trunk sewer which would drain the eighty-acre peat bog and its tributary slopes would require to have a diameter of 42 inches on Carolina Street in the middle of the area. As the city of Vancouver was carrying out nearly all sewer construction by day labor, it was decided to drive piles along the line of all sewers before starting construction. Some indications were then obtained of the depth and nature of the ground.

### Pile Driving Methods

Experience gained in the construction of a sewer at the northern boundary of the ward before inclusion into the city had shown that a steam pile driver would be required and one was designed with the leads hinged so that they could be lowered to pass under the numerous overhead wires. Nearly all the roads were planked, and some sewers were located off the centre line of streets to save taking up the planking.

Cedar piles not less than seven inches at the butt were used, nearly 30,000 lineal ft. in all being driven. The method adopted was to drive a test pile to refusal, measure the length, deduct one foot less than the depth of trench, cut a pile to this length and drive it below the surface by a dolly made of Australian hardwood with iron rings shrunk on and a steel dowel to hold onto the pile head.

Many piles far exceeded in length the height of the pile driver and short piles were first driven, then drawn out, the long pile inserted and forced down into the hole by block and tackle until it could come under the hammer. The plan Fig 1 shows the area which is covered by bog over 5 feet deep; and figures in circles indicate the depth below surface to which piles have been driven at these locations.

The change from hardpan to deep bog is particularly abrupt along the southern edge. Where excavation has been carried down below the peat along this belt a glacial mud has been found, consisting mainly of sand of unusual fineness. This proved very troublesome to excavate, as it was soft enough to flow upwards from the bottom of the trenches, and piles had to be jacked down until the foundation concrete could be got in.

The average cost of piles delivered on the streets was 7½ cents per foot, and the total cost of pile driving was made up thus.

| | |
|---|---|
| Piles | $2,233.04 |
| Coal | 109.58 |
| Oil, etc. | 20.69 |
| Lumber | 17.38 |
| Rollers | 25.87 |
| Moving machine | 18.00 |
| Refixing light wires pulled down | 26.01 |
| | $2,450.57 |
| Labor | 2,527.25 |
| | $4,977.82 |
| 3% for supervision | 149.33 |
| | $5,127.15 |

Or 17.21 cents per foot of pile in place.

### Shrinkage Was Very Marked

When the piling for the 42-inch diameter branch in Carolina street had been completed, construction was started by building a reinforced concrete sewer in situ on a plank foundation carried by the piles. This was found to be unsatisfactory, as the shrinkage of the ground adjoining the trench was so great, and the bottom of the trench was so unstable, that the delay in waiting for the concrete to harden led to serious difficulties with the timbering of the trench. It was decided, therefore, to substitute reinforced concrete pipe supported on a reinforced concrete cradle formed in situ on the plank foundation. With this arrangement it was found possible to close up the trenches in a shorter time than when the entire sewer was constructed in situ, and it also permitted the use of a cableway to carry the excavated material onto the top of the completed work. This caused less trouble than placing the spoil on one side. One of the illustrations, Fig. 2, shows a shrinkage of over 4 feet vertically along the deeper portion of the trench due to the drawing away of the water from the sides. Even when spoil was not placed alongside the trench, shrinkage was very marked, sometimes greater on one side than the other. A shrinkage of 2½ feet over the trench, diminishing to a few inches at 30 feet on each side, was quite usual, and not only was there no spoil to dispose of, but in addition a large quantity of material had to be hauled to bring the streets back to the original grade.

Most of the work was done by inexperienced labor employed as a means of giving relief during a period of unemployment. Thus the cost of the work varied from time to time, but was more seriously affected by continuing construction in the very wet weather which is seasonal at the coast during the winter months.

The following is a computation of the cost of one section of the foundation work:

| | | |
|---|---|---|
| Piling estimated to cost, per foot run of sewer....... | | $0.80 |
| Plank Foundation – | | |
| 5 pcs. 2 x 12 x 30 = 300 B.M. Cedar, @ $12.00.. | $3.60 | |
| 3 pcs. 4 x 12 x 5 = 60 B.M. Cedar, @ $12.00.. | .72 | |
| Nails ...................................... | .20 | |
| Labor, 12 hrs. at .34 ......................... | 4.08 | |
| | $8.60 | |
| Per foot run of sewer for 27 ft. net, say....... | | .32 |
| Concrete Base– | | |
| 6½ yards pit run gravel @ $1.25............... | 8.12 | |
| 29 sacks cement @ .59......................... | 17.11 | |
| Mixer charges ............................... | .50 | |
| Labor, 2 hrs. @ .34........................... | .68 | |
| Labor, 8 hrs. @ .31¼......................... | 2.50 | |
| Labor, 1 hr. @ .47............................ | .47 | |
| Laying and taking out forms— | | |
| Labor, 12 hrs. @ .31¼........................ | 3.75 | |
| Labor, 1 hr. @ .47............................ | .47 | |
| Triangular Mesh and Steel— | | |
| 33 lin. ft. No. 27 mesh, 4′ 10″, 160 sq. ft., per 100 @ $2.05 ................................ | 3.28 | |
| 66 ft. ¾ steel, 126 lbs. @ .02½................ | 3.15 | |
| 66 ft. ⅜ steel, 33 lbs. @ .02¾................ | .91 | |
| 30 ft. ¾ steel, 57 lbs. @ .02½................ | 1.42 | |
| Time Fixing Same— | | |
| Labor, 1 hr. @ .34............................ | .34 | |
| Labor, 1 hr. @ .31¼......................... | .31¼ | |
| | $43.01¼ | |
| Cost per foot run .................................. | | 1.35 |
| (Total quantity 6.75 cu. yds., cost per cu. yd., $6.37) | | |
| Total cost of foundation work per foot run of sewer.. | | $2.47 |

The backfill, when replaced, retained water on its surface (Fig. 3), and it took months to dry out. As might have been expected, the water gradually disappeared and after a prolonged dry spell cracks showed on the surface of the ground. Distinct lateral movements were noted during dry weather 12 months after the sewer had been completed. This was most pronounced at street intersections where smaller branch sewers were joined to the 42-inch sewer by means of short skew lengths at an angle of 45 degrees. The movement of the ground caused the distortion and collapse of some of these skews. When replacing them, additional piles were driven on each side of the pipes and capped across. The earth movement made it necessary to take up and relay some of the water mains. Fortunately no serious break occurred in these as the movement was so gradual.

### Settlement of Whole Area

The adjacent property, mainly cottages of a cheap class, was in most cases far enough away to escape serious damage. One house, however, which was close to a lane sewer 14 feet deep, gave some trouble. The precaution had been taken to drive piles to refusal as close to the house as possible. These were capped with a waling and sheet piles driven between. Notwithstanding this precaution, the house settled down on the side next to the trench to the extent of 15 inches. Two years after the construction of the main sewer the street was 2½ to 3 feet below the original grade and manholes showed above the surface and there is little doubt but that the whole area is from one to three feet lower than before the installation of the sewers.

The difficulties met with in providing drainage for this area, and the heavy prospective expense of replacing the present plank roads by permanent roads and sidewalks, forces the consideration of the question whether there is any justification for dividing up such reclaimed swamps into building lots for residential purposes. On tidal flats for industrial purposes, or on ground adjacent to main arteries of traffic, it may be necessary to utilize such land for building on. But where it adjoins merely residential property, it would certainly be better to reserve it for agricultural or park purposes. The city of Manchester, England, has utilized land of this description for over 30 years for

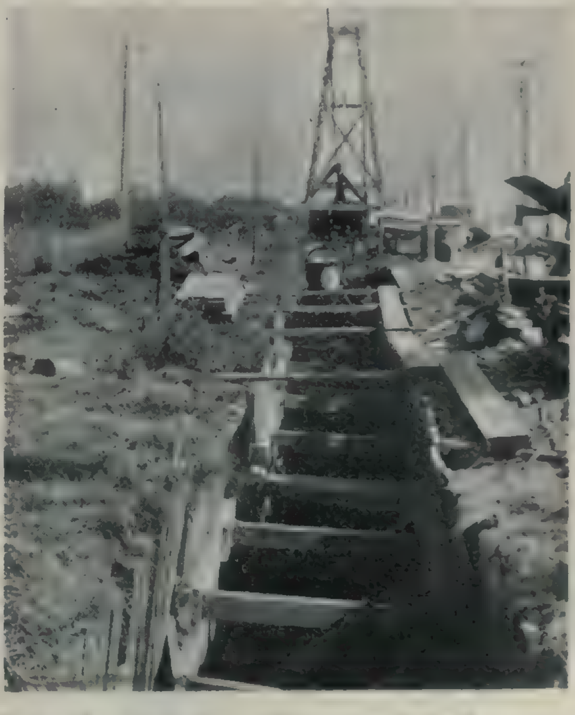

Fig. 4—Carolina St. Sewer, Vancouver, B.C. Excavation in muskeg, 18 ft. deep. Trench sides settle irregularly though no spoil is deposited on the sides. Notice pads between braces and walings. The pressure was so great that braces were squeezed into walings so that they could not be taken out until pad blocks were used.

disposal of city refuse, fifty tons of which are applied per acre annually for the land, which is intensively cultivated and made to yield a return on the capital expended.

Should any engineer be faced with the problem of taking a main sewer of brick or concrete construction through ground of this description it would be the best policy to prepare, if possible, some months before by digging a ditch down to grade and letting the ground drain out. Not only would construction difficulties be lessened, but more permanent construction would be insured. In this instance building development was so extensive that this procedure was impracticable, as the rapid drainage of the land would have destroyed many of the buildings which were not greatly harmed by gradual settlement.

### The Effect of the Ground Water on the Concrete

In replacing sewers destroyed by the movement of the earth as above mentioned, it was noted that the concrete which formed the bedding for the vitrified pipes on the plank foundation was not of the quality that was expected. Similar concrete from the same cement and gravel in other locations being found perfectly sound, the action of the ground water on the concrete was suspected. To rapidly test this theory two cement testers were asked to prepare standard cement briquettes of neat cement, and cement and sand in the proportion of one to three. These briquettes were equally divided after a 24-hour set in moist air and one half immersed in clean city water and the other half in a pit of water in the bog. Independent tests made at seven, fifteen and twenty-eight days showed reductions in strength averaging twelve per cent. in the tensile strength of the briquettes immersed in bog water. Whilst it was realized that these tests were too limited to be conclusive, it was deemed wise in the work of reconstruction to increase the proportions of cement and make greater efforts to keep the ground water away from the concrete until a partial set had been secured—a by no means easy task.

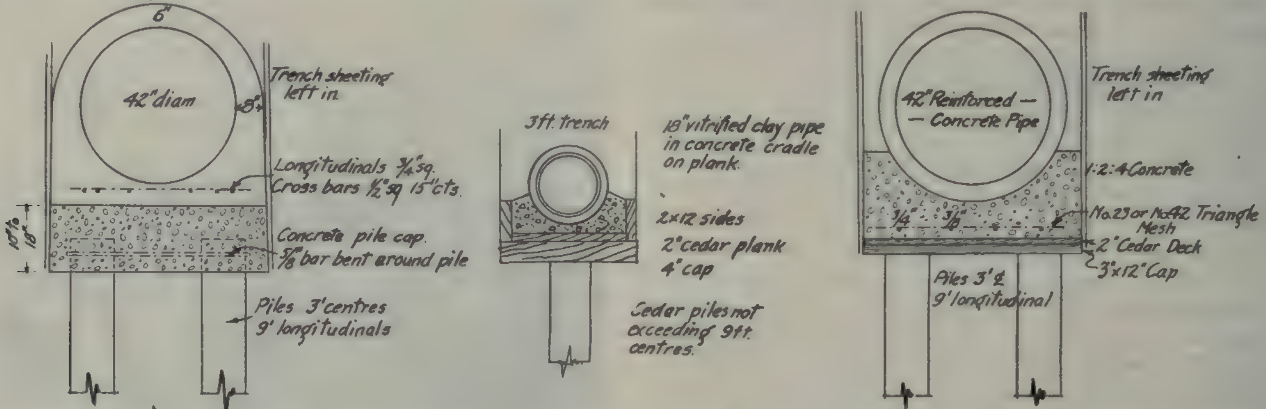

Fig. 5—From left to right: (a) section showing construction of sewer with concrete in situ; (b) section showing vitrified pipe in concrete cradle in timber boxing; (c) section showing construction of sewer with reinforced concrete pipe on reinforced concrete cradle.

Any doubt as to whether concrete may be affected by acid water of this description may, however, be dispelled as the result of work carried out by Mr. Duff A. Abrams of the Structural Materials Research Laboratory, Chicago, and recorded in Bulletin 7 of the Institute. Whilst in these tests tannic acid was added to the sand to represent an impure aggregate, similar results might be expected from the action of acid water, on a pure aggregate mixed with clean water, but submerged in impure water. Mr. Abrams states: "It has long been recognized that impurities of an organic nature have the effect of reducing the strength of concrete or entirely destroying the hydraulic properties of the cement. While this fact has been pointed out by a number of writers, there is still a tendency among concrete engineers to disregard the effect of such impurities." The following are some of the conclusions he arrived at as a result of the investigations:

"The strength of concrete was reduced for all percentages of tannic acid, for all mixes and ages covered by these tests. Less than 0.1 per cent. of tannic acid in terms of the weight of the aggregate may reduce the strength of the concrete to one-half its normal value."

"Lean mixtures are more affected by tannic acid than the rich ones."

"The results of these tests indicate that the wetter consistencies would be less affected by the presence of organic impurities than the drier ones."

The effect of ground water of this description on hardened concrete is more difficult to determine. At the time when the tests of the briquettes in the bog water were made the writer was furnished with an unpublished report to the Washington Geological Survey by Dr. H. K. Benson, Professor of Industrial Chemistry, University of Washington, and C. A. Newhall, chemical engineer of Seattle. This report, made at the request of the governor of the State, gave the results of an investigation into the failure of cement drain tile used in the reclamation of bog land of identical character to that described in this article.

Some of the conclusions reached by these investigations were:

"That cement tile properly made of good materials have failed in less than one year."

"That the failure appears due to corrosive action commencing on the outer surface and gradually disintegrating the tile."

"From a theoretical basis we believe that the cement is dissolved by soil solutions commonly known as bog or peat acids."

### Weak Alkalis and Acids Cause Disintegration

The action of alkali in soil solution on concrete has received more attention than the action of mild acids in the soil. The Engineering Institute of Canada has had committees at work for some years studying the

the deterioration of concrete exposed to alkali. The report of the Calgary committee presented at the tenth general professional meeting held at Saskatoon, August last in the final conclusion says: "The destruction of concrete in alkali districts has not as yet been proven to take place in strongly alkaline solutions. Experience appears, however, to point to the most severe action in the presence of sulphates and chlorides of sodium and magnesium soil solutions of not more than mildly alkaline reaction."

If this is true of alkaline reaction, may it not be equally true of acid reaction and that a mild acid in combination with the atmosphere may be more destructive than a strong acid. In the discussion on a paper by Mr. Newhall on the disintegration of concrete in railway tunnels read at a meeting of the Pacific Northwest Society of Engineers, Professor H. K. Benson said: "The paper by Mr. Newhall renews interest in the individual factors responsible for the decomposition of hardened cement. These factors are quite generally overlooked by engineers in their efforts to emphasize the physical conditions of mixing and proportioning the aggregate and in looking for harmful components in the sand and gravel. In taking these precautions, the chemical nature and properties of the cement compounds are often ignored. Several years ago a group of students in our chemical laboratories were interested in the action of carbon dioxide on hardened cement. They ground hardened cement pats, three to five years old, to a hundred mesh fineness, added distilled water and bubbled carbon dioxide gas through the cement powder in suspension. By repeating the operation several times, they found that all of the calcium and magnesium could be removed in the form of the soluble bicarbonates, leaving a residue of alumina and silica. Thus, by a common and relatively weak acid, cement can be completely disintegrated, provided the surface of reaction is sufficiently large."

There is a large field open for investigation in this direction by both engineers and chemists.

### Lessons From the Work

Summarizing the experience gained on this work, the writer would say:

That the method of driving the piles ahead of excavation was the cheapest way, but that occasionally it was found necessary to bring the pile driver back to redrive piles forced out of line by large roots or submerged bogs. That piles should be driven down harder than appears necessary to carry the load of the pipe sewer, because when the water has drained off and the top soil is light there is a tendency for the piles to rise. This was particularly noticeable in the fine glacial mud underlying the muskeg and sewers built on the borders of the district years before the drainage of the whole were affected by this upward movement.

That where possible it would be best to drain the land as far as possible ahead of construction by preliminary ditching. It is impossible to control either the lateral or upward movement of the bog unless this is done.

That the ground water should be kept away from the fresh concrete until it has thoroughly set.

That outside exposed surfaces of concrete should be finished off as smooth and tight as inside surfaces.

That as the shrinkage of the earth cannot be calculated, manholes should be finished with temporary tops until final settlement has been reached.

The consequence of drainage of land of this description is worth noting. Before deep drainage the ground with shallow drainage was wonderfully fertile for certain products. The deep drainage has made the ground too dry for those products, and artificial watering has little effect, so that cultivation of the ground is increasingly difficult. The dried peat quickly catches fire and when once alight is difficult to control. There is a considerable fire hazard thus created with the cheap class of frame buildings erected on the land. A fire started to burn garden rubbish may spread underground and when it reaches the drier ground under the house burst into flame.

It is said that the subdivision of this land was made in 1885, before the Canadian Pacific Railway had reached Vancouver, and that it was made by a survey of the outside lines only. It is certainly an instance of the folly of subdividing land far ahead of actual development and without a proper study of the topography and nature of the ground.

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## Main Committee of Canadian Engineering Standards Association Meets

### Considers Past Year's Accomplishments and Suggests New Activities—Cooperating With Other National Standardizing Bodies

The Sixth Meeting of the main committee of the Canadian Engineering Standards Association was held on Monday, October 17th, at the Association's office in Ottawa, Mr. H. H. Vaughan being in the chair.

After the transaction of formal business regarding appointments, resignations, and changes in membership of the various sectional and sub-committees, the secretary's report on the work accomplished since the last meeting was presented and approved.

During this period, meetings of working committees have been held as follows: Sub-committee on cement, June 27, 1921; sub-committee on watthour meters, Aug. 25, 1921; sub-committee on steel railway bridges, Sept. 12th and 26th; sub-committee on steel highway bridges, Oct 3rd-6th; panel on bridges, Oct. 3rd-6th.

The list of publications of the Association now stands as under: No. 1-1920, Standard Specification for Steel Railway Bridges; No. 1A-1920, Standard Specifications for Steel Railway Bridges, (Separate reprint of Material Specifications); No. 2-1920, Standard Requirements for Distribution Type Transformers; No. 3-1921, Standard Specifications for Galvanized Telegraph and Telephone Wire.

The specification for wire rope, as approved by the main committee in August, is now in the press and will shortly be issued.

The specification for steel railway bridges (No. 1-1920) being now out of print, active steps are being taken in preparing a new edition, in which a number of important alterations and improvements are being incorporated, with a view of bringing it into agreement with most recent practice of the large railway administrations.

The first draft of the highway bridge specification has been amended and is now being held, in order that it may be brought into general conformity with the provisions of the revised railway bridge specification.

The work of the sub-committee on incandescent lamps, wood poles for transmission lines, and watthour meters is actively proceeding.

The committee approved the list of members for the sub-committee on concrete and reinforced concrete and it is expected that this committee will commence its work at an early date with a view to preparing general specifications for these materials, based on the existing specifications of the Engineering Institute of Canada.

The specification for portland cement is being finally revised by the sectional committee, and will be submitted to the main committee for approval and publication at an early date.

### Future Activities

The committee next considered a number of suggestions as to future activities, and a communication forwarded from the Brantford Chamber of Commerce to the Department of Trade and Commerce, and passed to the C. E. S. A., was laid before the committee, in which attention was drawn to the desirability of Dominion-wide standardization of fire hose thread and couplings. The committee felt that this question is of considerable importance in Canada, and the secretary was directed to communicate with various authorities concerned, including the fire underwriters and the fire marshals, to obtain their opinions as to the best course to be taken.

The secretary reported that discussions were proceeding as to the best method of co-operation with the American Engineering Standards Committee in connection with their work on the safety code for elevators, the safety code for logging and sawmill machinery, tolerances on shafting, and standardization of gearing; in the latter case the association having been requested to nominate a representative to attend the meetings of the A. E. S. C. sectional committee.

Reports were presented regarding various points which were considered at the conference of secretaries held in London in May, and the committee approved the scheme for the systematic interchange of information between the various national standardizing bodies as to the condition and progress of their work.

The scheme outlined for the interchange of publications of the various national standardizing committees was approved as far as the C. E. S. A. is concerned.

Suggestions from the Dutch and Swedish standardizing committee were considered, respectively dealing with the round numbers to be adopted in official publications in giving the metric equivalent of inch sizes, and in regard to international action looking to agreement on the width across flats of nuts and bolt heads. Further enquiry and correspondence was directed in both these cases.

Discussion followed on points regarding organization and policy. A scheme for the periodical revision of the lists of members of working committees, and arrangement for the periodical revision of specifications were considered and approved.

The secretary reported the receipt of certain standard specifications issued by the Australian Institute of Science and Industry, and the interchange of publications with this Institute was authorized.

Correspondence, with offers of co-operation and assistance, was read from the Canadian Electrical Association and from the Electrical Co-operative Association of the Province of Quebec, and the committee expressed its appreciation of the kindness of these organizations.

The auditor's statement for the six months ending Sept. 30th was presented and was approved as being satisfactory.

# Prince Edward Hotel, Windsor, Ont., is Well Advanced

## Rapid Progress Being Made on Large Building—Steel Erected in Less Than Two Months—Interesting Foundation Design

The construction of the new Prince Edward hotel at Windsor, Ont., is well advanced, the erection of the structural steel having being completed on September 26th, although only having been commenced on August 1st.

The foundations for the building consist of spread footings, combined footings, and cantilevered footings, distributing the loads in such a way as to obtain a uniform pressure on the foundation soil, which is a very hard, blue clay, in which no water was encountered. It was impractical to go to rock with caissons with this building, in view of the depth of some 300 feet at which this formation occurs. The exterior retaining walls were carried approximately to grade, and acted as supports for the exterior steel columns, considerable saving in the time of erection of the building being effected in this way. This system of carrying the steel columns on the foundation walls or piers at the grade level is similar in this respect to the foundations of the King Edward Hotel, Toronto.

The building is designed for 14 storeys, but is being built to a height of only 10 storeys at the present time. The spandrel walls consist of 8 in. Denison interlocking tile with one course of face brick. Gypsum block partitions are being generally used throughout the building.

The architects for the building are Messrs. Esenwein & Johnson, with Messrs. Watt & Blackwell and Mr. A. H. McPhail as associate architects. Mr. R. E. W. Hagarty is consulting engineer on the foundations, structural steel frame work and reinforced concrete floors. The general contractors are Messrs. P. H. Secord & Sons Construction Company, Limited.

**A. C. B. C. I. Conference: January 17—22**

The next conference of the Association of Canadian Building and Construction Industries will be held in Hamilton, Ontario, on January 17th to 22nd, 1922.

# Controversy in Vancouver About Paving Materials

### City Engineer Fellowes Objects to the Laying of a Concrete Surface, Advocating Other Types in Preference—Mr. A. E. Foreman Criticizes his Arguments and Upholds Concrete as a Desirable Roadway

At a meeting some time ago of the Board of Works, Vancouver, B. C., a lengthy report by city engineer F. L. Fellowes, on the whole question of material for surfacing paved streets, was presented The occasion was the decision as to the paving of a new highway being constructed across the east end of the city, by the Great Northern Railway Company. The railway is making the street in lieu of building a number of additional overhead bridge crossings over its entrance to the city. The paved highway offers a new and much shorter artery into the centre of the city, and the whole cost is borne by the railway, the work to be to the satisfaction of the city. Mr. Fellowes' report is so outspoken in its antagonism to concrete as a paving material that it was decided to withhold its publication in the Contract Record until an opportunity was given for the other side of the case to be presented. As Mr. A. E. Foreman, district engineer at Vancouver for the Portland Cement Association and formerly public works engineer for British Columbia, has since replied to Mr. Fellowes' statements, the two reports may now be published side by side. leaving our readers to judge of the merits of the arguments. Mr. Fellowes' report appears first, followed by Mr. Foreman's reply.

## Mr. Fellowes' Report

Chairman and Members of the Board of Works:

As directed by your Committee of the Board of Works I herewith report on the application of Mr. A. E. Foreman, representing the Portland Cement Association, for permission to negotiate with the authorities of the Great Northern Railway Company for the laying of a one course concrete on the new highway, paralleling the G. N. Railway cut through Grandview and Mount Pleasant, as far as the intersection of 13th Avenue and Renfrew Street, for which the company are obligated to pay the initial or first cost of construction and laying, in a manner satisfactory to your engineer.

After giving this matter very serious consideration, weighing carefully the arguments and advantages claimed for the pavement by the Representative of the Cement Association, on repeated occasions, I have to recommend against any change in the Agreement permitting the laying of this class of pavement.

The introduction of one course concrete in the city of Vancouver as a policy is fraught with risk; and financial loss may result, not only to the city of Vancouver, but in following Vancouver's lead, to the municipalities of the lower mainland and possibly many other smaller cities and towns in British Columbia, who may from time to time accept to some extent our policy of maintenance, construction and general administration as a basis to work upon. As city engineer and as an engineer of thirty years' of municipal experience in laying and constructing pavements of varying kinds as well as in many other activities pertinent to the well-being of the community at large, I protest against approving of a class of pavement to be laid now or in the near future in the city of Vancouver or the Lower Mainland, which has only been laid, with few exceptions, a period of not more than five years and has yet to prove its worth.

Under the terms of the city's agreement with the Great Northern Railway Company, the particular clauses bearing on the type of pavement are set forth as follows:

Subsection 5 of clause 9 provides as follows:

> The railway company forthwith construct along said street a rocked road eighteen feet (18') in width and to a finished depth after final compression of eight inches, (8") extending from Clark Drive to Nanaimo Street and thence on thirteenth Avenue from Nanaimo Street to Renfrew Street.

Subsection 6 of the same clause provides as follows:

> The balance of such roadway is to be ultimately graded to conforn to such lines and levels as laid down and determined by the city engineer, to its full width. All work connected with the grading and rocking of said street to be done to the satisfaction and approval of the engineer of the city, both as to the general design of the roadway, quality and depth of material used, width of the road and crowns and approaches connected therewith and otherwise howsoever.

Your engineer, for the last six weeks, has been endeavouring with every prospect of success, to obtain the consent of the officials of the railway company to lay a standard asphalt pavement in preference to an ordinary rock road bound with tar, with a bituminous asphalt base thoroughly compressed to 4 in. to 4½ in. with 1½ in. asphaltic concrete or Warrenite bitulithic wearing surface.

### Objections to Concrete

My reasons for objecting to the laying of one course concrete on the 70 ft. Great Northern roadway are as follows:

1. The pavement is in the opinion of engineers in transitional or experimental stage.

2. In the case of the new driveway there are sections where heavy filling will be required; these heavy fills will settle and cause a fracture or breaking down of the slab which is rigid and brittle, unless sufficient time is given to allow complete settlement to take place.

3. This type of pavement has not been properly tried out, as a large percentage of the pavement has only been laid within the last four years.

4. If adopted as a standard of paving generally, for city requirements, it will necessitate tunneling for every sewer, gas and water connection at a very increased cost to the citizens.

5. The engineers are not agreed finally nor have they yet overcome the expansion and contraction problem; more particularly the contraction in concrete pavements, which

is causing them to crack and break open. From constructing a pavement 4 in. thick, which failed, they then increased the thickness to 5 in., then 6 in., and have now got to 7½ in. and 8 in., and the pavements, notwithstanding the increased thicknesses, are breaking down badly at the expansion joints and on the shoulders.

6. From a traffic standpoint in growing cities, the general movement and service will be seriously interfered with, as it requires from four to six weeks before the pavement can be thrown open for public service and that condition pertains in all repairs and renewals.

7. As to solving the problems of expansion and contraction under varying conditions of climatic change, engineers in England and America are experimenting and suggesting steel re-inforcement, to give added stability and to retard excessive stretching, and shrinking and of still greater importance, impact, pounding or hammer.

Impact or pounding is one of the most destructive agencies affecting the life of the pavement. Engineers are not prone to dwell at any length on this aspect of the question, for, so far, this condition has not been successfully met. Added thickness to the pavement is suggested and in some cases reinforcing is resorted to. This all means adding to the cost.

8. The Portland Cement Association and their engineers and many state engineers in the United States are still experimenting to a large extent in the matter of the proportions of mineral aggregate with the hope of overcoming the weakness developed by impact due to the ever-increasing truck loadings. To this end the proportions have been varied in the last five years from 1-3-6 to 1-2-3, and again to 1-1½-3. These altered proportions by volume provide not for an increase in mineral aggregate, but for an increase of four times the quantity of cement. It will readily be seen that this change is welcomed by the cement manufacturers and still the concrete pavement continues to break down and disintegrate.

9. The pavement being a rigid one, the constant impact on the pavement by modern trucks is developing a weakness which will cause, as time goes on, a serious impairment of the pavement, and is to-day involving the states of California and elsewhere, in a large and extensive programme of reconstructing many miles of one course concrete pavements which have failed for one reason or another.

### Value of Protective Wearing Surface

Owing to the ever-increasing tonnage which modern pavements have to bear, exhaustive tests were made to determine the real comparative values for different types and thicknesses of pavement for impact, the types being: (a) Straight concrete pavements; (b) concrete with sheet asphaltic concrete wearing surface 2 in. thick; (c) Asphaltic concrete base with 2 in. asphalt wearing surface. The results showed conclusively that with cement concrete protected by a 1½ in. to 2 in. sheet asphalt or asphaltic concrete wearing surface, the strength of the pavement is increased by the protection offered by asphalt, from 50 per cent to nearly 500 per cent, or from one-half to five times the strength of unprotected portland cement concrete.

### Advantages of Asphalt Concrete

The advantages of asphalt concrete are as follows: Asphalt as a cementing product can be refined to a fixed standard by distillation and fluxed in any quantity from a pound to a ton, the resulting product throughout the mass being uniform. This condition is not obtainable to the same extent in portland cement, either as a cement product in air-tight barrels or in sacks, or is absent in a more marked degree when cement is mixed on the site of the work by unskilled labor of concrete contractors.

The preparation of an asphaltic mineral aggregate wearing surface is made at the plant under the supervision of highly experienced and trained experts, every batch of 1,100 pounds being analyzed and checked before leaving the plant.

Owing to its viscosity, ductility and resiliency, asphalt will in a marked degree resist impact and hammer, much as a spring in a truck will absorb a sudden blow, which is a pronounced weakness in portland cement concrete pavements of the one course unprotected type.

In the case of a crushed rock or gravel base, poured or mixed at the plant, due to the viscosity and elasticity of the asphalt and its inherent stability when thoroughly mixed and compressed by rolling, such a pavement will, to a reasonable measure and extent, meet any settlement without cracking, and in such an event, repairs or re-surfacing can be readily and easily effected at a minimum of expense, which cannot be claimed for portland cement concrete pavements.

Another important advantage in the paving of streets with an asphaltic rock base, poured or mixed, topped with a 1½ in. to 2 in. wearing surface is that when desirable asphalt concrete pavements can be widened without trouble or danger to the existing pavement, providing an intimate bond between the old and new base and surface mixtures and elminating all transverse and longitudinal joints and providing a uniform surface. Should it be found necessary at a later date to widen the pavement—as in the case of all our rocked streets partially surfaced with asphale which have proved so satisfactory—at a minimum cost to the city, this can be done without risk in any way.

### Desirable Types

When the above reasons are taken into consideration in selecting a suitable pavement, particularly in the case of city paving, with proper regard to locality, soil, drainage and traffic conditions, any one of the following classes of pavement will insure greater stability, better protection from climatic changes, a lasting and a more impervious wearing surface and a marked saving in renewals, than any one course concrete pavement.

1. Asphalt concrete base of crushed rock or gravel treated with asphalt mixed at the plant in a modern pug mill from 4 in. to 12 in., depending on soil and drainage conditions, with wearing surface 1½ in. to 2 in., well rolled with a road roller of approved weight.

2. A portland cement concrete base, proportions 1-3-6 to 1-3-7, of thoroughly washed, clean sand and crushed rock or gravel and of approved gradings and classifications, protected by a 1½ in. to 2 in. asphaltic wearing surface mixture, with all mineral aggregate in the asphalt, carefully gauged and plant mixed.

3. Asphaltic wearing surface, 1½ in. to 2 in., on a well graded rock base, poured with asphalt, consolidated with a suitable road roller, local conditions governing as to subbase or foundation.

4. One course rock or gravel bituminous concrete from 4 in. to 10 in. depending on soil and drainage conditions, similar to the type laid on 14th Avenue nine years ago and today in perfect condition.

5. And one course or two course concrete only in cases where concentrated loads must be provided for and taken care of by a uniformly distributed load over a morass of unknown stability or compactness, to be surfaced with a carpet of asphalt paving materitl 1½ in. to 2 in. thick.

The press of the country is the only direct medium to which the public can in a direct way give expression to their grievances and complaints and in many states extensive articles are being written and reports published from independent bodies other than the various official commissioners who have the control and the awarding of contracts for pavements, complaining of the huge expenditures incurred, running into millions, in this class of pavement which has not stood up to the requirements, and they are now asking who is going to pay the bills for re-construction and maintenance.

On the complaint of, I believe, the engineers of fourteen counties of Southern California regarding the condition of pavements laid in this state, the Federal authorities who contributed some fifty per cent of the cost of the pavement on post or mail delivery roads, instituted an investigation with the result that about 30 per cent, so I am informed, of the pavements in the state are utterly worthless and have to be re-built; 20 per cent are showing signs of destruction and the remaining 50 per cent of the later or newly laid pavements are in fair condition or can be classed as good.

A very representative committee of the Automobile Association of Southern California, composed of three members, made independent exhaustive investigations, consulting county engineers as well as experts, and after getting all the evidence together, reported against the continuation of a policy of building concrete roads, recommending asphalt concrete or bitulithic on a concrete base or bituminous base.

In Minneapolis, 12 miles of pavement with a concrete base and a bitulithic top was awarded lately, at a cost in excess of the one course concrete cement bid of $10,000. When asked why the commissioners favoured this class of pavement, the answer was; that a one course concrete pavement laid by the state commissioners, which had been down only two years was going to pieces, and would have to be surfaced with asphalt concrete or bitulithic.

Coming nearer home, I have made an examination of the one course concrete pavements laid between Vancouver and Tacoma, laid within the last five years, and a series of photographs were taken of Sections between New Westminster and Seattle, showing where the pavements have utterly broken up and where large stretches of the pavements have been repaired, not with portland cement concrete but with bituminous concrete. The failures have been shown, in a marked degree, to be where one might expect, at the shoulders. Blocks have disintegrated and large triangular sections have broken out at the expansion joints, and where additional expansion cracks have developed due to heat and cold, further failures have developed. Coming still nearer home, on the Pacific Highway in the timber section and at other points, disintegration has already set in, notwithstanding the fact the greatest of care was taken on the part of the government engineers to ensure a first class paving product. The pavement has only been laid 10 months.

As the cost to the citizens, for re-construction and maintenance, owing to the rapid failure of miles of concrete roads already laid, will be enormous, it would be, in my opinion, a mistake to depart from the recognized standards which have stood the test of time, particularly in the large cities, where they are subject to all classes and conditions of traffic changes. We would hesitate, therefore, to depart from these standards to introduce a type of pavement which has not yet proved itself through time to withstand the modern automobile and heavy truck conditions, which are steadily growing and increasing.

The experience of men who are operating stage automobiles between Los Angeles and Bakerville on a one course concrete pavement and Los Angeles to San Diego on bituminous surface pavement, over a period of five years, report that the wear on the tires on the former is five times as great as on the latter. One is not surprised, therefore, that the Automobile Association of Southern California, which I believe has something like 57,000 members, is up in arms against the concrete pavements as laid in the past. Even the Federal commission which went so exhaustively into the causes of the failures, were not prepared to recommend the laying of an additional thickness of concrete over the disintegrating original base and as a result large sections of these pavements have been ploughed up at a very big expense, to be relaid possibly with portland cement concrete or concrete with an asphalt top.

### The Maintenance Question

Touching now the very important question of maintenance of various types of pavements. Let me direct your attention to the following as affecting the annual maintenance and upkeep:

The state highway department of the state of Michigan, contributes for all state roads 62.1 per cent of the cost of maintenance for all classes, including macadam, gravel and portland cement one course concrete or any similar type. The analysis and proportioning of the maintenance cost of these several types are as follows: Gravel $251.99 per mile; Macadam, $490.20 per mile; Concrete, $658.85 per mile with the following significant comment: "The high average of cement concrete is due to 78.94 miles in Monroe and Wayne Counties on which $68,296.76 was expended, making an average of $865.17 per mile." The report further states that no allowance is set aside for supervision and equipment estimated at $27.64 per mile, raising the cost to $892.81 per mile and this amount is spread over only seven months of the year.

[Mr. Fellowes at this juncture in his report lists some seventeen roads in the city of Vancouver and surrounding municipalities that "to his knowledge have not cost the municipalities one cent from the time they were laid to the present moment, a period of from ten to twelve years." These pavements are surfaced with 1½ to 2 inches of asphaltic conrete or Warrenite bitulithic on concrete foundations.—Editor]

Excerpts from the following well-known authorities are submitted:

Hugh W. Skidmore of the Chicago Paving Laboratory, an institution of high technical standing, covering a field of scientific investigations of paving and other structural materials, has the following to say as to bituminous or asphaltic paving material:

1. Provides homogeneity of mass and positive bond between foundations and wearing surface when bituminous top courses are employed.

2. Provides uniform contact with the sub-grade, thus insuring the benefit structurally of all the beam strength possessed by the foundation slab and, by the same token, makes certain uniform distribution of load to the sub-grade.

3. Because of the inherent flexibility of the material, the foundation slab will at no time be called upon to act as an arch over weak sub-grade areas; therefore, the possibility of the foundation rupturing, as is frequently the case with portland cement concrete, will be reduced to a minimum.

4. Provides freedom from cracks and upheavals.

5. Insures against the presence of moisture in the foundation structures, thus prolonging the life of the pavement.

6. May be easily repaired at minimum cost, the surface patch method being applicable except in the case of very serious defects.

7. Provides decided economies in construction.

8. Does away with the long period of time required for curing of the foundation, thus permitting the opening of

completed work to traffic immediately and providing a rapidity of turnover to the contractor not possible in the case of rigid foundations.

9. Under similar conditions, using the same aggregate materials, bituminous concrete of equal thickness will be found to be cheaper than cement concrete at present prices.

Mr. Charles A. Mullen, a highly experienced man, both scientifically and practically, in the construction of pavements and who is a directing head of Dr. Milton Hersey's Laboratories in Montreal, with a large experience in Canada and the United States, states as follows:

> "The modern cement concrete pavement seems to many to be an important innovation; and it is an important one—**To Avoid**. It may be that the only way some officials will learn their real value, or lack of it, is by experience. They are likely to get this experience within the next five years.

Prof. Arthur Blanchard, a man of international repute, with whom your engineer has had many conversations and interviews, covering his investigations with all types of pavements including concrete and bituminous, does not consider that a concrete pavement has suitable surface wearing qualities under modern conditions, but does favor the concrete as a base, properly constructed with a bituminous black top surface for wearing purposes.

Mr. J. W. Howard, consulting engineer on roads and pavements, New York, with an experience of over 25 years states:

> "Portland cement concrete is too rigid and brittle to sustain the wear of heavy traffic and climatic changes without cracking and wearing into holes and ruts. All portland cement concrete pavements and roads which have been in use for two years have proved faulty in the above particulars."

The Engineering Commission on Tenders for the construction of the justly famous Columbia River Highway, of Oregon State, after careful consideration of various types of pavement including portland cement concrete, approved of and awarded a contract for the construction of 2 in. of bitulithic on 4 in. of crushed rock compacted. The Commission in support of its recommendations, quote the following authorities: Mr. Frederick P. Spalding, Professor of Civil Engineering, University of Missouri; Prof. E. H. McAllister, University of Oregon; Mr. Paul E. Green, especially commissioned to report on the concrete road system of Wayne County, Michigan.

Mr. Green has the following to say of the portland cement concrete pavements laid in Wayne county, Michigan, in 1909, 1910, 1911, 1912:

> "Practically all cases of concrete pavements on city streets observed by the writer in the last five years, have cracked badly before they are two years old. In most cases they are also badly worn. The statement is true of Windsor, Ontario, and of the Wayne County roads, where it was observed that 32% of the individual slabs of the 1909 work and 21% of the 1912 work is cracking and showing signs of wear (inspection made 1913). All streets and roads observed which have a considerable commercial traffic and which are more than one year old are wearing badly."

Another very interesting report, bearing on the maintenance and upkeep of one course concrete pavement in the state of Oregon, U. S. A., by Mr. Samuel Benson, Chairman of the Oregon State Highway Commission to Governor Olcott, November 13th, 1920, reads thus:

> "Less than one year ago, the concrete pavement between Portland and Hillsboro was thrown open for traffic and in this short time it has so deteriorated and worn that to save and preserve it, it is imperative that a surface must be provided for. With this practical experience and illustration in mind, I am opposed to laying this character of surface in Western Oregon. Even if the initial cost is less, I am convinced the cost of maintenance will be prohibitive."

It is hardly necessary to quote further. I have in my possession a sheaf of additional reports, telegrams, newspaper clippings from all over the United States, practically condemning one course concrete as a wearing surface in pavement construction, and condemning it in no uncertain language.

The agreement with the Great Northern Railway authorities provides amongst other things, that they will rock the new highway to a depth of 8 inches, penetrated or poured with tar or asphalt. As already stated, it is optional which product they use for binding purposes. As tar is much cheaper than asphalt, they have every intention of using it. I have been endeavoring to get a better and more lasting surface by the use of asphalt as a binder, with the hope of some success. In the face of our own experience with cement concrete and for the reasons above quoted, I could not recommend the laying of a cement concrete pavement, even if we had the right and power to do so, without the consent of the railway company, who pays the initial cost, which the city must maintain afterwards—for this is where the real burden lies.

If the Great Northern Railway Company demur at laying any one of the above types of pavement, due to the additional cost over the treated rock road, provided for under the agreement, it will be in our best interest to construct the rocked road as specified for under the agreement.

## Mr. Foreman's Reply

Chairman and Members of the Board of Works:

In replying to the report on concrete pavements which the city engineer submitted, I shall not deal with each individual statement in that report and answer it in detail, but shall endeavour to show the exaggerated and distorted tone of the report by taking a number of the more important statements and proving them to be absolutely incorrect and misleading.

I shall quote authorities, official reports and statistics to show that concrete pavements are not the experiment and risk that the city engineer claims; that 4-inch rock base with or without the application of asphalt by the penetration method and with a 1½-inch asphaltic concrete or bitulithic top is not considered good engineering practice but has been practically abandoned owing to present and prospective heavy truck traffic, and to prove above two statements I shall quote some of the city engineer's own authorities.

Among Mr. Fellowes' reasons for not laying one-course concrete is: "This type of pavement has not been properly tried out, as a large percentage of the pavement has only been laid within the last four years." Concrete pavements were laid before the bitulithic pavement was patented and at the end of 1917—about 4 years ago—there were 100,000 sqare yards of concrete pavement in the United States and Canada. Results secured from these pavements have been so satisfactory that a further 148,000,000 square yards have been laid or contracted for since that date, or over 248,000,000 square yards in all, equivalent to about 23,500 miles of pavement 18 feet wide.

The following table shows the yards of concrete pavements awarded during the first six months of this year in different states as compared with yardage of all other types combined.

| State | Spuare Yards Concrete | to | Square Yards All Other Types Combined |
|---|---|---|---|
| Washington | 12.4 | | 1 |
| West Virginia | 2.5 | | 1 |
| Iowa | 2.8 | | 1 |
| Southern California and Arizona | 7.2 | | 1 |
| Wisconsin | 11.3 | | 1 |
| Michigan | 9.1 | | 1 |
| Minnesota | 2.2 | | 1 |
| Northern California | 2.8 | | 1 |

Also, the state of New York awarded contracts for over 3,866,000 square yards of concrete pavements during first six months of this year, or nearly three times the yardage that was awarded during the corresponding period of 1920. Besides the states mentioned above, the following have awarded contracts during the first six months of this year for from two to seven times the yardage awarded during the corresponding period last year: Maryland, Ohio, Oklahoma, Mississippi, Kentucky, Alabama and Vermont.

Up to the present contracts have been awarded for concrete this year in United States and Canada at the rate of about 1,200,000 square yards per week, and on August 23 the Illinois Highway Department will receive bids on approximately 145 miles of concrete roads involving 1,500,000 square yards, and yet the city engineer claims it is an experiment fraught with risk.

The City of Windsor, Ontario, has been laying concrete pavements continually since 1907 until they have a million square yards of this type of pavement and over 30 municipalities in Ontario have concrete pavements in course of construction at the present time.

The city of Victoria has one-course concrete on Shelbourne Street which was laid in 1916. There has not been a cent spent on it for repairs to date and it is in excellent condition.

### Condition in California

In his report the city engineer states that: "On the complaint of, I believe, the engineers of fourteen counties of Southern California regarding the condition of pavements laid in this state, the federal authorities who contributed some 50% of the cost of the pavement on post or mail delivery roads, instituted an investigation with the result that about 30%, so I am informed, of the provements in the State are utterly worthless and have to be rebuilt; 20% are showing signs of destruction and remaining 50% of the later or newly laid pavements are in fair condition or can be classed as good." The actual facts of the case are that this investigation was undertaken by the United States Bureau of Public Roads at the request of the California Highway Commission and Highway Engineer, made on June 25, 1920. The chief of the Bureau of Public Roads states that this report is "the most comprehensive study of results obtained through the development of a state highway system that has yet been undertaken." In this report concrete pavements are classified as to their condition under six classes, A, B, C, D, E, and F, and on page 74 it states: "Classes A to C inclusive are for practical purposes at present equally serviceable to traffic. Class D seldom presents bad travel condition; Class E includes some pavement which is rough to travel and Class F in several instances presented pavement very difficult to travel." Table 22 on page 78 shows 87.5% to be in Classes A to C and only 12.5% in Classes D to F, and of the defective pavements in Classes D, E and F, 70% occur on soils of Class 1, which includes all adobe soils. There is a radical difference between these percentages and those Mr. Fellows would lead you to believe were in the government report.

Further, on page 33, part 2, of the Automobile Association engineers' report on the California state highway system, it states: "There can be no doubt under any condition that adobe has been a contributing or probably the major cause (of failure) in every instance."

### Government Approval of Concrete

The favorable attitude of the United States Federal Roads Department towards concrete roads in apparent from an article appearing in the "Building and Engineerng News" of Saturday, July 23, 1921, which states that:

"Figures on approved Federal Aid projects under construction and completed up to March 1, 1921, involve 22,032 miles of road. The following table shows the percentage of the total cost as distributed among the various types—

| | |
|---|---|
| Concrete—plain and reinforced | 38.464% |
| Bituminous—(practically all of which is on concrete base) | 5.548% |
| Brick | 4.799% |

whereas the balance is made up of grading, gravelling and building of bridges."

In other words the United States government has approved of an expenditure of seven times the amount on concrete roads that it has on bituminous roads and note the latter are practically all on a concrete base.

The city engineer's report also states that a committee of the Automobile Association of Southern California made investigations and reported against the continuation of a policy of building concrete roads recommending asphalt concrete or bitulithic on a concrete base or bituminous base." The Automobile Club of Southern California and the California State Automobile Association of Northern California did, in July 1920, appoint four consulting engineers, J. B. Lippincott of Los Angeles; H. J. Brunnier, San Francisco, C. Derleith, Jr., Berkeley, and Walter C. Howe, San Francisco, to make a thorough investigation of the California State Highway System and a very exhaustive examination was carried out at a cost of about $50,000, but they did not report against the building of concrete roads. They did just the opposite and they did not recommend asphaltic concrete or bitulithic. Let me quote from their Conclusions:

"——it is not intended to convey the impression that the undersigned are opposed to the construction of concrete highways. The contrary is true. We believe that the most satisfactory type of pavement to stand heavy traffic conditions particularly on insecure foundations, is an adequately and properly built concrete slab."

Again quoting from Page 83, Part 2:

"From our investigations and observations of concrete roads in California and elswhere covering a period of many years, we are of the opinion that a thin bituminous or skintop wearing surface applied to a first-class concrete road is an unnecessary and unwarranted expenditure if its use is for the purpose of preventing wear or abrasion of the concrete surface. A well designed concrete road of high quality, honestly constructed and efficiently supervised, is one of the most attractive highways that can be built. If it is structurally right, it will require no surfacing and without such surfacing it will be less slippery and consequently a safer road for wet weather traffic."

The city engineer objects to concrete as a wearing surface. On page 162 of the Report of the United States Office of Public Roads it states that from their investigations the concrete roads show no wear by traffic and on page 163 that: "Concrete should be laid not as a base but as a wearing surface."

On page 82, part 2 of the Report of the engineers for the Automobile Association it states: "It is our opinion that the wear on the California Highway Commission's concrete roads is negligible. This is based on a personal inspection trip over practically the entire state system."

On page 83, part 2, of the same report, they quote Edward N. Hines, Chairman of the Wayne County Road Commissioners as stating in September 1916 that:

"Woodward Avenue road, the oldest concrete road in Wayne County, is now in its eighth year of service. It has carried an estimated total traffic of over 7,000,000 vehicles of all kinds from motor cars to heavy traction engines, and the wear on its surface has been so slight that it is difficult to measure."

And Mr. Hines on pages 5 and 6 of a report published by the Detroit Automobile Club in April 1916 states that.

"Since 1908 and 1909 when we designed and built our first concrete road, we have standardized and built practically our entire mileage of concrete. We believe there is greater value per dollar in concrete than any other material. Comparative low first cost, ease of traction, freedom from dust and dirt, reasonable maintenance cost, durability, freedom from patents and royalties, non-slipperiness, capacity for resurfacing and widening with concrete in the case of the narrower roads, easy riding, and availability of materials, have been the determining factors in our decision. We consider as quite well settled for present and reasonable future conditions the question of surfacing, as to design, construction and maintenance, and our effort is rather to foresee future needs."

### Other Arguments for Concrete

Philadelphia has just installed the largest municipally-owned asphalt paving plant in America, but is using it exclusively for repair work, and when considering the paving of the Roosevelt Boulevard, which will be part of the Lincoln Highway and one of their finest streets, decided to use concrete. (Engineering News Record", July 21, 1921, Page 102 and "Lincoln Highway Forum", July 1921, Page 1)

Seattle has its own asphalt paving plant but in 1920 86 per cent of the contracts awarded was for concrete and the balance for brick.

The city of Portland owns its own asphalt paving plant, but notwithstanding this, nearly 50 per cent of the contracts awarded for paving this year is for concrete. Mr. Dulin, superintendent of the plant, in his Annual Report to the city commissioner, for the fiscal year 1919 states:

"The attention of the reader is particularly called to the summary of Table No. IX which shows in a most conclusive and convincing manner that the cost of maintenance and upkeep of portland cement concrete pavements is far less than for bitumitfous pavements. This table proves without doubt that concrete pavement is much superior to bituminous pavement and that in the interest of economy and sound engineering the city should abandon the laying of bituminous pavement in favor of concrete pavement, except in the case of redressing old macadam streets where the lower first cost of laying a 2-inch asphaltic concrete wearing surface offsets the increased cost of maintenance."

### Concrete on the Lincoln Highway

The technical committee of the Lincoln Highway Association includes in its membership some of the foremost highway engineers in the United States and the personnel of the Committee has collectively jurisdiction over the expenditure of considerably more than a quarter of a billion dollars for highways, and when considering the best type or pavement for the "ideal section" of the Lincoln Highway they unaminously decided upon concrete (Lincoln Highway Forum, January 1921.)

The California Automobile Association Engineers' report on page 74 states that: "The concrete pavement has become the one most universally used for the construction of state highways in the United States."

To say that concrete pavements are an experiment and a risk in the face of these facts and figures and to refuse to even try them out indicates a lamentable ignorance of present-day engineering practice if nothing else. I know of but one other place on the north Pacific Coast which does not call for alternative bids for concrete and that is the small town Brownsville, Oregon.

The city engineer early in his report refers to the inconvenience when repairing concrete pavements. The hundreds of cities throughout the continent which are laying concrete pavements have no difficuty in this regard and the city of Nanaimo is repairing its bituminous pavements with concrete and finds it both satisfactory and economical, as the only large equipment necessary is a wheelbarrow as compared with a road roller, asphalt plant, asphalt heater, asphalt burner, etc. which are required to properly repair black pavements.

Secondly, with reference to a 4-inch or 4½-inch rock base with or without an application of asphalt by the penetration method and 1½-inch bituminous top:

The Asphalt Association of New York issues valuable booklets on the best methods of road construction when using asphalt and in Brochure No. 6, page 5, on foundations, it states: "Broken stone foundations for ordinary traffic should seldom be less than six inches thick and for heavy traffic should run from 8 to 12 inches in thickness."

### Concrete for Foundations

Charles Mullen, one of the authorities quoted by the city engineer, referring to foundations in his book, "Paving Economy—Road and Street" states:

"While there may be and are many differences of opinion as to which is the most economical and desirable wearing surface for the pavement, there are hardly any who do not recognize the standard 6-inch thick and approximately 1:3:6 mixture Portland cement concrete foudation as the most economical and suitable base for all pavement surfaces of both classes. A wearing surface laid upon a foundation that is not sufficient, of whatever character that foundation may be, can hardly be termed a pavement at all, and certainly it is waste of money to lay a good wearing surface upon a defective base."

Clifford Richardson, the foremost authority on asphalt pavements in America and who is retained by the asphalt interests, states on page 14 of his book "Asphalt Construction":

"In the early days of the sheet-asphalt paving industry a so-called bituminous foundation consisting of a coarse broken stone bound to a certain extent with some form of bituminous material, was in use, but this has been entirely abandoned in good practice, as it possessed no rigidity, and for the same reason it should be abandoned on country highways."

And on page 8 he states: "The most satisfatcory foundation for any form of highway surface, including both city streets, and country roads, is one of hydraulic concrete of sufficient thickness."

Arthur Blanchard, also mentioned by the city engineer, when reporting on paving work in Colorado Springs in the spring of 1920, recommended against the 4-inch rock base, and in his report stated: "I am postive the weak 4-inch rock base described in the specifications would prove wholly inadequate for the local conditions in the case of the four streets under consideration."—and he recommended a concrete base.

### Repairs to Bitulithic Pavements

Saanich Municipality has by far the largest mileage of pavement consisting of 2-inch bitulithic top on a 4-inch rock base of any municipality in British Columbia. These roads have not yet been down five years and they were repaired in 1919, again in 1920, and are undergoing extensive repairs at the present time. Last year the Saanich Council found it necessary to pass a resolution probiting the "Carriage of articles weighing over four tons" on these asphaltic pavements between the hour of 10 a.m. and 8 p.m.

The State Highway Department of Oregon awarded a contract within the last two months for resurfacing 5 miles of the McMinnville-Tillamook Highway—which is the same type of construction—at a price many thousands of dollars higher than it cost originally to construct the road three years ago. Also, a contract was let in 1919 to pave 6 miles of the Island City-La Grande-Hot Lake Road in Oregon with 2 inches of bitulithic on a 6-inch rock base. The section laid in 1919 commenced to go to pieces before the road was completed and it was necessary to increase the thickness of the uncompleted portion to 2-inch bituminous top on a 3-inch bituminous base on crushed rock and to resurface and add 3 inches of bituminous base to the greater part of the section which was completed in 1919.

These and similar experiences elsewhere in Oregon resulted in the Highway Department abandoning this type of pavement as being too light for present day truck traffic. They not only increased their minimum requirements from

2 inches of bituminous top on a 4-inch rock base to 2 inches of bituminous top on 3 inches bituminous base on 4 inches of rock sub-base, but they actually added the 3 inches of bituminous base on some 120 miles of pavement for which contracts had been awarded in 1919 for the lighter type, and at an increased cost of about $2,000,000. Also the United States Government will no longer approve of the lighter type of construction in Oregon on roads towards which they are giving assistance.

### Not Good Practice

The above evidence, I think, should be sufficient to show that a 1½-inch or 2-inch bituminous top on a 4-inch rock base is not good engineering practice under present heavy truck traffic conditions, and I would suggest that your honorable body write the chief engineer of the Oregon State Highway Department and the Reeve of Saanich for information with regard to their experience with this type of pavement so that you may benefit by that experience.

I shall now point out a number of other errors and misleading statements in the city engineer's report. Referring to California roads, he states: "Even the Federal Commission which went so exhaustively into the causes of the failures, were not prepared to recommend the laying of an additional thickness of concrete over the disintegrating original base." This is not in accordance with the facts. On page 162 in summing up their conclusions it says: "It is doubtful if much of the pavement of these classes (D to F), especially on "adobe" will ultimately prove an adequate base for a 1½-inch Topeka top. An adequate "second-storey" concrete construction if extended to a total width of 20 feet to thus include two new concrete shoulders of full depth, is to be preferred."

Referring to the Columbia River Highway he states: "Laid seven years. In first class condition. No maintenance expenditure to date." I shall quote from the "Oregonian" for August 11, 1921:

> "A controversy in which the Warren Construction Company figured was initiated with the presentation of two bills totalling $13,568.25 by that concern for repairs to the upper Columbia river highway. Commissioners appeared surprised when told by Chapman that they already had approved similar bills to the total of $600 and that the matter for which the present bills were rendered had been taken up with them before.
>
> Chapman was asked how it was the Warren Construction Company was allowed bills for repairs on hihway when under their ten-year maintenance bond it was required to keep the roadway in repair without further expense to the county."

The auditor's books for Multnomah County show that besides the above amount, the county has paid $5,083.70 for repairs that the company carried out under their maintenance bond. The auditor's books also show that Multnomah County has paid repair bills this year on the St. Helens Road (Lower Columbia River Highway) which is about 16 miles long, to the amount of $18,884.06

### Situation in Vancouver

The city engineer states in his report: "Concrete pavements in the city of Vancouver and surrounding municipalities surfaced with 1½" to 2" asphaltic concrete or Warrenite bitulithic and which has not cost city municipalities one cent to my knowledge from the time they were laid to the present moment, a period of from 10 to 12 years." If the city engineer will look up his own printed report for the fiscal year 1912, page 34, he will see that there was not a yard of bitulithic pavement in the City of Vancouver twelve years ago and not a yard of asphaltic concrete ten years ago, and further there was not a yard of asphaltic concrete in the surrounding municipalities nine years ago.

I would also remind him that the bitulithic pavement on Kingsway in South Vancouver has been down about six years; that extensive repairs were carried out last year and that it is badly wheel-rutted at the present time. Granville Street between 16th and 25th has been repaired and is in need of repairs at the present time, and there is a great difference between the quality of these 2-inch bituminous surfaces with a concrete base and when they are on a rock base as recommend for the Great Northern Road and as laid on Comox Street this year.

In the report he refers to the state of Minnesota. I may say that during the first seven months of this year there have been awarded in this state contracts for 1,100,000 square yards of concrete as compared with 680,000 square yards for the entire year of 1920, and that 65 per cent of the awards for city pavements in the entire State during the first six months of this year has been for concrete. On the same page he refers to the unsatisfactory condition of the concrete pavement between Vancouver and Tacoma. It is interesting to know that every county between Blaine and Tacoma, and in fact every county in the State of Washington, is laying its entire paving program this year with Portland cement concrete, and the Engineers for the California State Automobile Association on page 68, part 2 of their report state that: "One has but to ride over the Washington roads and note their uniformity and symmetrical lines to be convinced that our sister state is well advanced in the latest and most modern method of design and construction."

Again the city engineer states that as "tar is much cheaper than asphalt they have every intention of using it." To my knowledge tarvia has never been cheaper than asphalt in B. C. during the last ten years and the price has usually been considerably higher.

He states that rocked streets at present partially surfaced with asphalt could be widened and provide a uniform surface at a minimum cost. An experienced engineer knows that the macadam has been placed on the majority of these streets without regard to either the grade or crown necessary for a hard-surfaced pavement and that satisfactory results could not be secured by widening as he suggests.

### Why a Two-Course Pavement?

The city engineer recommends a one-course or two-course concrete pavement only "over a morass of unknown stability or compactness, to be surfaced with a carpet of asphalt paving material 1" to 2" thick." If the city engineer or any other engineer can give a good reason for laying a two-course concrete pavement and then covering it with a bituminous surface, it would be of interest to the engineering profession as would also the name of any experienced highway engineer who would endorse the laying of a "one-course rock or gravel bituminous concrete" 10 inches thick.

He refers to varying the proportions of the concrete and enriching the mix with the result that there is an increase of four times in the quantity of cement used. In the great majority of states and provinces the proportions for the standard one-course concrete pavement are 1:2:3. If Mr. Fellowes will look up his tables on concrete he will find that the quantity of cement in this mix is two-thirds greater than for the 1:3:6 mix, which is usually used in foudations, and not four times as he claims.

I think the above are sufficient to show the inaccuracies with which the city engineer's report abounds.

In January last I endeavoured to have the city engineer approach the railway company re the laying of a one-course concrete pavement instead of 8 inches of rock with a bituminous coating. He stated that they would not, and the city could not stand the extra expense. Later I was able to secure quotations whereby 6 inches of 1:2:3 concrete could have been laid at no increased cost to the city but the city engineer refused to consider concrete.

Mr. Greene, New York State Highway Commissioner, stated recently that among the uneconomic types of road to construct in the light of present day traffic are the water-bound macadam and the bituminous macadam and he added: "Such pavements, if you build enough miles of them, will bankrupt the state to maintain them." There is no doubt that the 8 inches of rock with a bituminous coating will require a surfacing in a comparatively short time and if this is done similarly to the work the city is doing on other streets to-day and at the same price it will cost about $30,000 besides the cost of maintaining the road in the meantime.

If 6 inches of 1:2:3 concrete had been laid it would not only have made a better foundation than any in the city at the present time—if it were ever necessary to use it as such—but I am satisfied in view of the above evidence that it would not have required surfacing for a great many years.

I would also respectfully recommend that your honorable body consider favorably the paving of the section of Main Street with concrete where the bridge is being replaced. The yardage is small; in the light of experience in Seattle and elsewhere, the risk is neither great nor costly, and it is an excellent opportunity to try out this type of pavement.

# Lumber Interests Roused on Anti-Shingle Propaganda

## Circular Issued by Canadian Lumbermen's Association States the Stand of the Industry on the Proposed Legislation Prohibiting Shingles as a Roofing Material—Ask for Thorough Inquiry into Roof Coverings

Much has been said regarding the alleged fire menace of the wooden shingle. The attacks on this roof covering have been fierce and frequent in both Canada and the United States during the last few months.

It was announced that in the Ontario Legislature last spring there would be a bill introduced practically prohibiting the use of the shingle for roofing purposes. It was intended that the legislation should prevent shingles from being used on roofs on any buildings hereafter to be erected nearer than 50 feet to an existing structure, and that the same regulation regarding distance would apply in all cases of extensive repairs.

Owing to the strenuous fight which the lumber interests put up and the opposition from other public bodies against the proposed legislation, it was dropped for the time being. Many statements made by the advocates of the bill were claimed to be unfounded and misleading, and an attempt was made to show that cedar shingles had not been the cause of nearly as large a number of fire as alleged.

In this connection an interesting announcement has lately been sent out to the lumber industry by Frank Hawkins of Ottawa, secretary of the Canadian Lumbermen's Association. He pointed out that a determined effort has been put forth during the past year, and more particularly in Ontario, to introduce legislation looking toward the abolition of the wooden shingle. Mr. Hawkins says that the advocates of this measure camouflage the issue by pretending that they are asking that the wooden shingle may not be permitted to be used on any new buildings or on old buildings in the way of repairs, within fifty feet of one another. Stripped of all verbiage, it means the total extinction of the wooden shingle, and if adopted in one province the danger of spreading the disease to other provinces is imminent. The announcement continues:

"The third annual convention of the Dominion Fire Prevention Association was held in Ottawa lately and the advocates of this prohibitive movement, together with numerous representatives of patent and metal shingles and also the executive of the Fire Chiefs' Association were present in force.

"Mr. J. B. Laidlaw, general manager of the Norwich Union Fire Insurance Co., of Toronto, opened the discussion by stating that he was there not as an insurance man, but as a private individual, and although he opposed the use of wooden shingles (with the fifty-foot reserve clause), his statements were considerably modified from his previous diatribe in this regard. It is only fair to state that the Canadian Fire Underwriters' Association and others do not uphold Mr. Laidlaw in this matter.

Mr. George F. Lewis, deputy fire marshal for the Province of Ontario, and also secretary of the Ontario Fire Prevention League, was as pronounced as ever in claiming that not only should the fire loss caused by sparks on roofs be all charged to the wooden shingle, but that the conflagration loss was also directly attributable to the use of wooden shingles.

### An Inquiry Into Roof Coverings

"Mr. Robson Black, secretary of the Canadian Forestry Association, who had just returned from the Pacific Coast, spoke regarding the conditions and attitude in the West. The secretary also produced certain evidence based on facts which disproved the utterly wild statements made by the two principal speakers on the other side. However, it was quite apparent that if the matter had been allowed to reach the resolution stage an adverse verdict would have been given against the wooden shingle. This was avoided by the introduction of the following resolution moved by the secretary:

> Resolved,—That it is expedient an impartial committee be appointed by the chairman and secretary of this association to examine, test and report upon the various kinds of roof coverings ordinarily sold in Canada, with reference especially to:
>
> (a) Combustibility.
>
> (b) Qualities to communicate fire to other buildings.

(c) Cost both for material as sold in bulk and for placing in position on roofs.

(d) Durability and cost of maintenance.

(e) Appearance on roofs.

(f) What treatment could be applied to roofings ordinarily combustible, to render them fire resistive, both before placing on roof or subsequently when in position both to a new or old roof covering.

(g) To fix standards and official names for each roofing reported upon.

Insofar as tests of wooden shingles are concerned, it is expected that they will be of shingles untreated, and of shingles treated with chemicals intended to make them fire resistive.

The committee to be empowered to make use of all available reports and impartial tests of roof coverings now available and to report to the executive of this association, it being understood the report of the committee will be at once transmitted to all members and others interested.

"The resolution keeps the wooden shingle on the map for the present. This will give the lumber trade of Canada sufficient time to enable them to take such steps as they may consider necessary to defeat the aims and objects of the opponents of wooden shingles.

"This subject will be made a special feature of the coming annual convention to be held at the King Edward Hotel, Toronto, January 11th and 12th next, and all persons interested in this matter are cordially invited to attend the convention, bring their ammunition and take part in the deliberations."

### CITY MANAGER FOR CHATHAM, ONT.

The city of Chatham, Ontario, on January 1 will adopt the city manager plan of government. This city manager will have control of all the city departments, under the jurisdiction of the city council, which will be composed of seven members. Under this system the mayor and council will become, in effect, a Board of Directors for the city's business, and the city manager will correspond to the general manager of an industrial company.

### NAME MISSPELLED

By an error in typography, the subject of our "Canada's Engineers" sketch, in our issue of October 12, was spelled "Mr. W. Chace Thomson" instead of "W. Chase Thomson."

# Rusted Reinforcement Causes Failure of Concrete Roof Slab

## Portion of Marlborough-Blenheim Hotel, Atlantic City, Falls After Wire Mesh in Cinder Concrete Slab Becomes Weakened by Corrosion Due to Moisture Coming Through Tension Cracks

The failure of part of the roof slab over the kitchen of the Marlborough-Blenheim Hotel in Atlantic City on August the 9th is one more striking example of the corrosion of reinforcement in concrete slabs. The failure occurred shortly after 1.00 p.m., with no warning and with no load on the slab except the weight of the slab itself. The hotel was constructed about fifteen years ago and the kitchen section was two storeys high, both floors being of reinforced concrete, one resting directly on the sand and the other of terra-cotta construction supported on cast iron columns. The section of the slab that failed was an 8 in. cinder concrete slab reinforced with galvanized iron wire mesh with the wires spaced 4 in. and 5 in. on centres, one edge resting on a concrete beam, and the other supported on a brick wall. A waterproofing material was laid on the slab and a walk way had been constructed over part of the collapsed section.

A longitudinal crack, caused by the corrosion of the metal, developed near the centre of the slab and one half, using the concrete beam as a hinge, fell down to the floor below, the other half pushing the outside wall over and falling with it to the ground. Along the edge of the crack the corrosion of some of the wires was clearly visible, some being almost entirely rusted through, while others were evidently tension failures shown by the necking and cup-shaped fractures. Failure of these wires occurred because of the extremely high stress put on them by the cracking of the other portion of the slab.

The failure of the slab can be attributed solely to the progressive corrosion of the reinforced wires and, although the hotel was situated on the sea coast, the wires were in no way subjected to the corrosive effect of salt air and no prominence can be given to this fact as the cause of the corrosion and subsequent failure. The moisture that weakened the wires came through the bottom of the slab, which as stated above, was over the kitchen section and the atmosphere of a kitchen, in continuous service cannot contain a measurable quantity of the salt spray and mist attributed to sea-shore corrosion.

In conclusion, it might be well to point out that when this hotel was built fifteen years ago, a great amount of discussion took place over this type of construction and it was maintained by many that corrosion of the reinforcement, due to moisture entering through the tension cracks, would in time so weaken the wires that failure of the slabs and beams would result. The fact that this controversy gradually died out is due to the fact that up to the present, there have been no failures due directly to this cause, but it is to be expected that as time goes on and corrosion progresses past the point where the factor of safety takes care of the reduced area in the reinforcement, more failures of this type will be reported.

# Half Million Dollar Church in Quebec

## Eglise du St. Sacrement will be Completed Next Year—A Very Fine Edifice Carried Out in Dressed Granite—Details of Architecture and Construction

The RR.PP. du Saint Sacrement, of Quebec, have under construction a large church which is located on Ste. Foye road, near the entrance to Quebec City, by the provincial highway.

From an architectural point of view it has been designed by Charles Bernier, architect, of Montreal, in a style which is between the Romanesque and the Gothic in the 13th century. Many features, of course, have been modernized. The external dimensions are 240 feet for the length and 90 feet for the width, while the transept is 122 feet long. The facade, which is 40 feet wide by 100 feet high, is flanked by two square towers, 30 feet wide by 144 feet high.

Eglise du St. Sacrement as it will arrear when completed·

The front will be adorned with a number of sculptured figures. The doors, which are of bronze and the copper framing for all the windows will be supplied by McFarlane and Douglass, of Ottawa, at a cost of $20,000.00. Over the main entrance will be placed a large mosaic panel, which is being executed by the Daprato Co. of Chicago.

The foundations were excavated to an average depth of 12 feet, while under the apse they were taken down to a depth of 25 feet so as to provide room for the heating apparatus, etc. The material excavated was found to be shale and hard-pan. The foundation walls, with footings as wide as 12 feet at some places, were built of solid concrete up to the level of the original surface of the ground; over 2,000 cubic yards of concrete were used.

Dressed granite from Riviere à Pierre, P.Q., and Beauce, P.Q., is being used exclusively for the exterior. Some 55,000 square feet of cut stone will be required and the cost will be $102,000.00. Hollow terra-cotta and 1,500,000 common bricks, supplied by the Citadel Brick & Paving Block Co., Limited, of Quebec, will be used on the inside lining of the walls and towers.

The floors and roofs are supported by structural steel framing and trusses built and erected by the Eastern Canada Steel and Iron Works, Limited, of Quebec, at a cost of $41,000.00. They are made of hollow reinforced concrete beams furnished by the Canadian Siegwart Beam Co., Limited, of Montreal. The roof covering will be of copper and has been contracted for by Michel Chouinard, of Montreal, at a cost of $15,000.00.

The interior consists of a large nave, with "triforium," a transept of the same height and two lower aisles. The nave will be 192 feet long, 42 feet wide and 78 feet high. The aisles are 20 feet wide by 30 feet high. The choir, which is 5 feet above the floor in the nave and aisle, is 40 feet deep. The basement or crypt contains a large chapel which will accommodate 1,500 people. It has a clear height of 18 feet, with vaulted ceiling.

Terrazzo and ceramic will be used all over the floors, while the plinths, at the base of the walls, and all the stairs will be made of marble slabs. That specialty will be handled by the Lepage Marble Works, Limited, of Montreal, at a cost of $25,000.00.

The walls, columns, ceilings and vaults, in the interior, will be finished with a coating of special cement mortar laid on metallic lath; imitated joints will be moulded in the plastering which will give the impression of cut sand-stone.

That church will be absolutely fireproof; with the exception of the choir stalls, the pews and the organ, which, of course, will be of wood, all the other building materials used in its construction are incombustible.

The church under construction.

The heating system is of the low pressure steam type. The boiler is located in the basement under the rear end of the church; it will furnish steam to the church and to the convent occupied by the Fathers, which is a six-storey brick building standing right behind the new church. The radiators in the church will have a heating surface of 45,000 feet. Jobin &

Paquet, Regd., of Quebec, will install the system at a cost of $22,000.00.

The organ has been ordered from Casavant Bros., of St. Hyacinthe, P.Q., and will cost around $40,000.00. Excepting the organ loft, there will be no gallery, but accommodation will be provided in the pews, on the main floor, for 2,000 people.

The general contract was awarded to J. L. Fauteux, of St. Benoit, P.Q. Work on the excavation was started in the spring of 1920, and the foundations, as well as the steel structure, were erected during the following season. It is expected that the exterior walls and roof will be completed before the coming winter. The inside works will then be executed without delay and the church will very likely be open to the parishioners by the end of 1922.

When completed, this magnificent church will have cost over $500,000.00. Oscar Beaulé, architect, of Quebec, is supervising the erection and is looking after the details of construction.

## Hamilton, Ont., Masons Sign Up with Contractors' Association

The decision on the wages question between the General Contractors' Section of the Association of Canadian Building & Construction Industries, Hamilton Branch, and the Bricklayers' and Masons' Union, of Hamilton, which has been hanging fire for some time, was brought to a head on October 25 by the arrangement of an agreement under which the union accepts the standard of 90 cents an hour. The agreement is in force from November 1, 1921, to April 1, 1923, but the rate of wages is only fixed until April 1, 1922. The agreement provides that in January, 1922, negotiations shall be undertaken between the two parties as to the rate to be paid after April 1, 1922. In this way, the new rates will be determined before the old ones cease to function—a much more satisweefactory arrangement for both sides. The 44-hour week is recognized as standard, extra time being considered time-and-a-half.

Section 8 of the agreement is important in that it provides that there shall be no cessation of work pending any dispute. A joint arbitration board is provided to endeavor to adjust points at issue, and in case of non-agreement, the International Union is to be called in. In no case is work to be discotinued by the men during these negotiations.

Another important section of the agreement reads to the effect that the labor union recognizes the Hamilton Branch of the Association "as the only authoritative body in the district, representing employers of masons for the purpose of making this or any agreement affecting the trade, or any changes to be made in same from time to time."

### International Bridge Project

A Board of Directors, consisting of Detroit and Windsor men, was elected recently to supervise the international bridge project between these two cities. The Canadian officers included: Hiram H. Walker, Charles S. King, A. F. Healy, Dr. J. O. Reaume, and Charles Evan Fowler, the latter the chief engineer in charge of the design and construction of the bridge.

### WORCESTER FIRE EXTINGUISHER CO. OPENS MONTREAL OFFICE

The Worcester Fire Extinguisher Company, Ltd., have opened Montreal offices at 137 McGill street under the management of Mr. S. Skidmore. Mr. Skidmore is well known in the province of Quebec, having been engaged in the fire extinguisher business in that locality for a number of years. This firm will act as sole Canadian agents for the Rockwood Sprinkler Company, of Boston, Mass.

### Mr. F. Jno. Bell Resigns

Announcement is made of the resignation of Mr. F. Jno. Bell as president and general manager of Canada Wire & Cable Company, Toronto, manufacturers of electrical wires and cables, with factories at Leaside, Ontario, and branch offices in different cities of the Dominion from Halifax to Vancouver. Mr. Bell has also resigned as president and general manager of Leaside Engineering Co., which corporation controls the cable company and other firms, including Leaside Munitions Co., manufacturers of shells during the war for the British and American Governments. Prior to joining the cable company in 1913 Mr. Bell was general manager and secretary of British Canadian Power Co., supplying electric power and compressed air to the silver mines of Cobalt and South Lorain in the Northern Ontario Mining District.

### New Catalogues

Gillis & Geoghegan, Sherbrooke, Quebec, have just issued a new 20 page, 8½ ×11 inch two-color catalog. It is fully illustrated with photographs of actual installations of G & G Telescopic Hoists, as used for handling ash cans, barrels, trays and other loads. It also contains two forms of specification for each model, one a very short form and another which describes the various parts of a complete Telescopic Hoist installation. Any one interested may obtain a copy by writing the firm.

### Personal

Mr. C. L. Trimmingham, who is agent for the Ontario Gypsum Company in the province of Quebec, is now located at 14 St. John Street, Montreal.

Mr. S. L. Squires, of Toronto, chairman of the executive of the Canadian Good Roads Association, addressed the fall meeting of the Eastern Townships Associated Boards of Trade, held recently at Sutton, P.Q., on the subject of "Good Roads." Other speakers who dealt with the above subject were Senator Geo. C. Foster; Mr. C. A. Smith, road commissioner of Bristol, N.H.; Hon. Mr. Vilas; W. R. Oliver, M.L.A.; Col. Payne, Granby; and P. Duboyce, of Richmond, P.Q.

Mr. J. C. Townley, formerly district manager of the Pittsburgh office of the Cement-Gun Co., Inc., sailed for Holland October 15th, where he will take up his duties as general manager of the International Cement-Gun Company. The International Cement-Gun Company has been recently organized to handle the foreign business for the Cement-Gun Company, Inc., with the exception of Canada, Mexico and Cuba. The address of the company is 50 Maria Plaats, Utrecht, Holland.

Mr. A. C. Trory, formerly with the Dickie Construction Co., Ltd., at Toronto, has gone into the general contracting business on his own account, with office in Galt, Ont. Mr. Trory has just secured a contract for the erection of an arena for the Galt Athletic Association at an estimated cost of $90,000. Work has begun on the foundations, and it is hoped to have the building completed by the first of February, 1922.

In addition to the company mentioned above, Mr. Trory has had experience with P. H. Secord & Sons of Brantford; the J. D. Evans Engineering Co. of New York City; the Imperial Construction Co., Toronto; the W. C. Edwards Co., Ottawa; and the Henry Morgan Co., Montreal.

## Obituary

Sir John Kennedy, prominent consulting engineer, of Montreal, died recently at that city, aged 83. Deceased, who was born at Spencerville, Ont., built the first double-track railway in Canada, the line from Glencoe to Windsor. He had been connected with the port of Montreal for 46 years, retiring from business life in 1907, due to failure of his sight, which later developed into total blindness. Previous to his connection with the harbor development, deceased was chief engineer of the Great Western Railway System, at that time the largest system in Canada. He graduated from McGill University 60 years ago.

## Trade Incorporations

The People Construction Co., Ltd., with head office at Montreal, capital $50,000, to carry on the business of general contractors.

The M. & H. Construction Co. Ltd. with head office at 73 Pearl St., Toronto, capital $50,000, to carry on the business of general contractors.

Ontario Foundation & Engineering Co. Ltd., with head office at Toronto, capital $50,000, to carry on the business of contractors, builders and manufacturers.

Notice of the incorporation of the Burrard Dry Dock Company, Limited, at Vancouver, N. C. appeared in a recent issue of the "Canada Gazette". The company is capitalized at $1,000,000, with head office at North Vancouver. They will construct a dry dock at Vancouver harbor.

## Mainly Constructional

### East and West—From Coast to Coast

Fire losses in Canada during the week ended October 19th are estimated by the Monetary Times at $509,750, compared with $184,900 the previous week.

The Toronto Plumbing Supply Company has opened an office and warehouse at 1218 Dundas St. W. Mr. Atkinson is the manager.

That the housing scheme is progressing favorably at Hamilton, Ont., is indicated by a recent report which states that requests for loans for houses totalling approximately $100,000 in value have been received.

The Canadian National Railways, it is stated, has announced that the much desired branch line between Kamloops, B.C., and Kelowna, B.C., will be commenced this fall, bridge equipment being already on the way.

The Canadian Pacific Railway Company has presented the town of Ingersoll, Ont., with a 7-acre gravel pit, in return for a quantity of gravel taken from a corporation pit several years ago.

A recent report states that a meeting of several New York manufacturers and financiers has been called for November 14th, at that city, to further the interests of the St. Lawrence River development scheme.

The Pacific Coast Association of Building Owners and Managers opened a two-day conference at Vancouver on Friday, Oct. 21st. This is the first time this association has met on the Canadian side of the line.

A report made public recently is to the effect that Reuter's correspondent at Cape Town, South Africa, has officially announced that the contract for the erection of 36 grain elevators in that country will be placed with a Canadian contractor, subject to certain formalities.

The Stephen Construction Company, of St. John, N.B., have taken over the Lee Brickyard, at East St. John, and intend thoroughly overhauling the plant and installing new equipment of improved type. The property includes twenty-five acres of land and has a half-mile frontage on Courtenay Bay.

The principals behind the recent drive to secure $45,000 for the equipment of the Fraser Memorial Hospital and other expansion work at the Victoria Public Hospital, Fredericton, N.B., have been successful in obtaining the desired funds; in fact, their objective has been over-subscribed.

Plans for the construction of an $800,000 technical school to serve the municipalities of Windsor and Walkerville, Ont., have been approved by the Joint Technical School Board, and a start on the breaking of ground at the site, Elsmere Avenue and Giles Boulevard, is anticipated within a few weeks.

The new technical school at Niagara Falls was formally opened about two weeks ago by Dr. Grant, Minister of Education, with several school authorities and prominent local business men in attendance. The school, when fully equipped, will have cost $250,000.

Messrs. F. Chapman Clemensha, of Regina, and W. S. Allward, of Toronto, were the joint winners in the Dominion competition for designs of battlefield memorials for erection on the site of the eight famous Canadian battlefields in France and Flanders. Seventeen designs were submitted by architects and sculptors from all over Canada.

For the purpose of obtaining information and general data in respect to the project to lower the waters of Lesser Slave lake, north of Edmonton, Mr. E. Brydone Jack, of Victoria, superintending engineer for Western Canada, of the federal department of public works, was in Edmonton recently, accompanied by Mr. J. E. St. Laurent, also a government engineer, of Winnipeg.

The Great War Veteran's Association, at its recent convention in Port Arthur, adopted a resolution to petition the Dominion government to amend the Land Settlement Act to enable returned soldiers to borrow amounts sufficient to build their own homes, at the same rate and under the same conditions as the soldier-farmers receive them.

One of the largest dredges in the world is at present nearing completion at the yards of the Canadian Vickers, Ltd., at Montreal, and is expected to be handed over to the owner, the department of marine and fisheries, in a few weeks. It will probably be operated on the ship channel below Quebec, and will leave for that port immediately on delivery. The dredge is 284 feet long between perpendiculars, and 292 feet long over all, with a breadth of 48 feet and a depth of 20½ feet.

The Michigan Pikes' Association has decided to carry out its annual scheme of circuiting one of the Great Lakes with a tour in the interests of better highways and the popularization of through touring routes next year. The 1922 tour will be around Lake Michigan; the 1921 event was around Lake Superior, and the 1920 was a circuit of Lake Huron. The event, as in all previous years, will start from Detroit and finish there. The tentative date is July 9, and it is planned to make it a 15-day campaign. Mr. W. D. Edenburn will be in charge of the tour.

ESTABLISHED 1886

# Contract Record and Engineering Review

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## *A Reserve Building Fund for Periods of Depression*

Our neighbors to the south recently held a conference on the unemployment situation. Some of the most important industrialists in the United States were present, as the conference was called on the expressed wish of President Harding. The secretary of the conference, Mr. E. E. Hunt, recently made the following logical statement: "If all branches of public works and construction work of public utilities could systematically put aside financial reserves, in prosperity, to be used for improvements and expansion in depression, the recurring periods of business depression might be avoided, or at least greatly decreased, and the consequent unemployment of labor might be much less serious and widespread." Continung, Mr. Hunt urged that, if we maintain a reserve of only 10 per cent. of our average annual construction expenditures, we could almost iron out the fluctuations in employment.

This suggestion of Mr. Hunt's is well worthy of attention. After all, he is merely suggesting a policy that would be entirely in line with that of many private organizations to-day. There are few industries, for example, that do not lay aside reserves for a rainy day. More particularly, perhaps, is this seen in the study of the financial reports of large corporations. Frequently profits running in the neighborhood of 20, 25, even 50 per cent. are made in certain years, but the management does not consider it wise to pay this all out to the shareholders. They foresee years ahead when there may be no profits or there may be actual losses. Consequently a dividend reserve is built up to carry the investors over the lean period. There are some very satisfactory examples of that among the Canadian industrial class right now. For example, the steel trade has gone through one of the worst depressions in its history, yet one of our largest companies has given assurance to its shareholders that they had prepared for this period by setting aside from the larger profits of former years.

It may not be so easy to set aside a certain portion of the money available for construction work, but it may look more difficult than it really is. To begin with, the periods of depression are fairly well marked. Past history indicates clearly enough that boom and depression follow one another with irresistible certainty. Where is the impossibility in the Dominion or provincial governments, in boom times, mapping out their building program for the coming year, providing the money in the usual way and then setting aside, say, 5 per cent. of it—to be added to next year, if the boom continues, or to be drawn upon if the cycle of changes has brought us around to a period of depression?

Periodic depressions, just like private financial calamities, are the result of a lack of proper foresight. The individual or the corporation that makes it a fixed policy to set aside something each year for a rainy day, doesn't, later in life, find himself or itself cast upon the shores of poverty and senility. It is by a judicious policy that we iron out the bulges in the life curve, whether that curve refers to the individual, private corporation, or the nation as a whole. Unemployment is an economic waste, an absolute loss of national wealth, just as much as a big fire is. This is a big enough problem for our governing bodies to take hold of vigorously.

The present moment is not, of course, the time to advocate the setting aside of reserves. On the other hand, we are just emerging from a period which has impressed upon us the necessity for guarding against the recurrence of such difficult times, and we should be wise enough to profit by experience and plan to-day for the conditions to be met in the future.

## *Regulations Governing Importation of Construction Materials*

The following service letter issued by the Association of Canadian Building and Construction Industries is of interest to every contractor who buys material and equipment from foreign manufacturers:

The attention of our members is directed to a customs tariff amendment which comes into force December 31st, 1921. It provides that all goods imported into Canada which are capable of being marked without injury shall be so marked as to indicate the country of origin. Penalties, to be imposed on the importer are provided for non-compliance with the regulations issued by the department of customs and excise.

Pending publication by the department of summary of various rulings, which have been given, we have received the following letter from the commissioner of customs in reply to our special enquiry.

"I have the honour to acknowledge the receipt of your letter of the 28th instant, with regard to the indication of the country of origin required on certain products imported by members of your Association. In reply I beg to advise you, as follows, with regard to the marking required on the commodities referred to:

"Each of the following articles to have the required indications of the country of origin thereon: Doors,

*No. 68*

# *Canada's Engineers—Geo. F. Porter*

McGill University, on October 13, conferred upon Mr. George F. Porter, chief engineer of the Canadian Bridge Company, of Walkerville, Ont., the honorary degree of Doctor of Laws, in recognition of his outstanding engineering ability in connection with the building of the Quebec Bridge.

Mr. Porter is a remarkable example of native ability and industry. Unlike most engineers, he did not have the benefit of a college education, his schooling being limited to that available in his youthful days in the public schools of Detroit. By constant study and hard work, he qualified himself for the engineering profession and is now recognized as one of the foremost bridge engineers in the world, his fame resting securely on his achievement in the successful design, manufacture and erection of the Quebec Bridge.

He was born in Detroit, on October 7 1862, and educated in the public schools there. His professional career includes his employment by Mason L. Brown, civil engineer of Detroit, in general practice from 1885 to 1894, and for the following years he was employed by the Detroit Bridge and Iron Works, going to The Keystone Bridge Works, Pittsburg, Pa., in 1896. .He returned to the Detroit Bridge and Iron Works in 1897 and was closely connected with the construction of the Victoria Jubilee bridge at Montreal and the International bridge over the Niagara River at Bridgeburg, Ont. In 1900, he assisted in the founding and organizing of the Canadian Bridge Company, Limited, Walkerville, and continued with this company, in charge of the draughting department until January 1, 1909. During this period the company built many of the important railroad and highway bridges in Canada, including the Lethbridge Viaduct for the Canadian Pacific Railway—the greatest structure of its kind in the world.

In January, 1909, he was appointed to the staff of the Board of Engineers appointed by the Dominion government to design a bridge to cross the St. Lawrence River, near Quebec, to replace the one that had failed in 1907. In this connection he had charge of the draughting department and was largely responsible for designing the details. The board having completed their design in June, 1910, he was appointed by the Canadian and Dominion Bridge Companies, who combined their interests to tender on the work, to prepare estimates and work out details for a competitive design. The tenders were submitted in competition with three other bridge companies and, after careful consideration, the contract was awarded to the St. Lawrence Bridge Company, the corporation formed to combine the interests of the Dominion and Canadian Bridge Companies.

Owing to difficulties encountered in building the main piers, it was decided to increase the length of the main span, and thought advisable to make some changes in the general outline as well. Mr. Porter prepared the outline of the bridge as now built which received the final approval of the contracting parties. This necessitated a great amount of additional work in the preparation of the final plans. As engineer of construction of the company he had direct charge, organizing and executing all the work in connection with the design, fabrication and erection, including the construction of the special shop, and erection equipment required for the execution of the work.

Mr. Geo. F. Porter

In May and June, 1918, when the bridge was near its final completion, Mr. Porter was sent by the courtesy of the St. Lawrence Bridge Company to give illustrated talks on the erection of the bridge before many of the branches of the Engineering Institute of Canada, and also before many engineering societies of the United States.

Mr. Porter is a member of the Detroit Engineering Society, the Engineering Institute of Canada, American Society of Civil Engineers and the American Railway Bridge and Building Association.

window sash, shovels and picks, iron pipe, iron pipe fittings.

"The following articles are not required to be marked: Rough lumber, dressed lumber, marble and stone in the rough, face brick, rough brick, enamelled brick and tile, hollow building brick.

"The following commodities, if imported in compliance with the provisions of section 18 of the regulations, would be exempt from marking: Sheet metal, steel for reinforcing, structural steel.

"The following articles will be required to have an indication of the country of origin on each package or container: Portland cement, wall plaster, lime, paints, oils, glass for glazing, locks, bolts, nails and screws.

Each of the following articles have the required indication of the country of origin on a name plate securely affixed thereto, or stamped or stencilled on the principal part thereof: Mechanical mixers and mechanical hoists."

# Up-to-the-Minute Design for New Hosiery Factory

## Plant of the Holeproof Hosiery Company of Canada, Ltd., London, Ont., Combines Every Feature That Will Make Employees Comfortable and Efficient—First Unit of an Aesthetic Group of Buildings

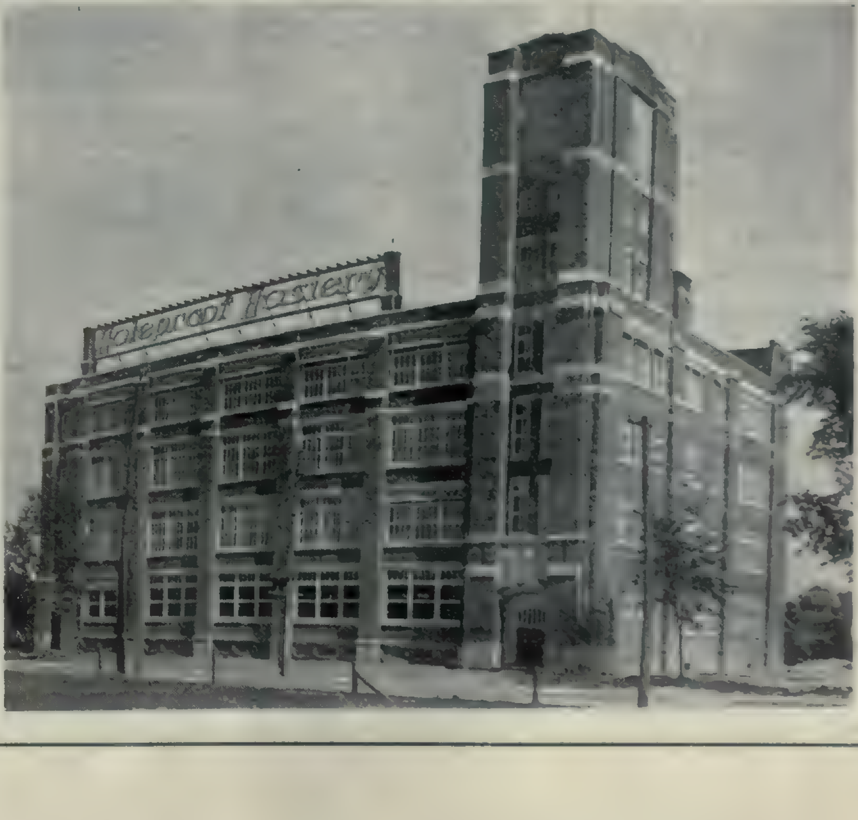
H. P. ELLIOTT, Consulting Engineer, Toronto and London, Ont.
LOCKWOOD, GREENE & CO. of CANADA, LTD., Associate Engineers, Montreal, P. Q.

Engineers in designing a building to be used for manufacturing must be guided by certain general instructions from the owners. In many cases these instructions merely refer to the size or capacity of the manufacturing plant, no special attention being paid to the general architectural features of the exterior and the sanitary arrangements and devices for the comfort and safety of the employees are the minimum called for by provincial and municipal laws and ordinances. Many employers of labor have found however, that the employees are more efficient and that a higher class of labor can be obtained if not only the best facilities are provided for carrying out the work in the way of labor, tools, and efficient arrangements of all kinds but also, if the work rooms are clean, well ventilated, well lighted and comfortably heated. Many of the largest employers go a step farther and are of the opinion that it pays to consider the aesthetic features for the interior and exterior both for the advertising value and for the effect upon the employees.

The owners of the Holeproof Hosiery Co., London, Ont., instructed their engineers to design a plant which would be the most convenient and efficient that it was possible to build and that would embody everything possible for the health, safety, convenience and comfort of its employees. They stipulated that the building should have a pleasing exterior and should follow the lines of some established order of architecture and that the effect should be obtained by the general lines, proportions and disposition of the masses rather than by artificial ornamentation.

After considering the present and probable future requirements of the business, the engineers made a block plan showing five buildings each approximately of the size of the first unit to be erected. The building which is the subject of these notes has a frontage of 150 feet, a depth of 85 feet and has four stories and basement. The next unit to be erected will complete the front, making it symmetrical in relation to the tower. The remaining three buildings with the units already mentioned will make a U-shaped group with the shipping and receiving platforms, driveways, railroad sidings and underground coal bunkers in the court. The present unit includes the underground coal bunkers, central steam plant, etc. There is a switch track which reaches four railroads.

The building is of reinforced concrete, flat slab construction. The tower houses a 30,000 gallon



The new plant of the Holeproof Hosiery Co. has been designed to be more than strictly utilitarian. Pleasing architecture gives it character and has an important beneficial effect on the workmanship of employees. The unit shown will ultimately be extended, making the building symmetrical with the tower.

sprinkler tank in its upper story and the two 8,000 gallon tanks for soft water in its lower storey.

The whole exterior of the building is veneered with Don Valley, oriental rug, pressed brick, specially selected. It is trimmed with the best quality Bedford stone (Indiana limestone).

The general dimensions of this building as already given were chosen to suit manufacturing requirements. The heights from floor to floor are greater than usual and were considered proper for light and ventilation: Basement, 10 feet; first, second and third, 14 ft. 6 ins.; fourth, 16 ft. The height of the tower is 114 feet above the sidewalk.

In order to leave the floors entirely unobstructed the stairways, toilets, elevator shafts and ventilating ducts are kept at one end and occupy a space of twelve feet running clear across the width of 85 feet. An extra stairway is built in a shaft outside the rectangle of the building. The columns are 27 feet apart.

The dye house is upon the top floor and the working floor of this department consists of heavy wood slats about 18 inches above the solid floor. Under the whole dye house is a tank, 18 ins. deep lined with 1½ ins. of Trinidad Lake asphalt. This tank is formed of concrete and properly drained to floor drains and prevents danger of any leakage to the floors below. The steam dryers for drying and shaping the dyed goods and the stock rooms for undyed goods are also located on this floor. The winding, knitting, ribbing and cutting departments are on the third floor. Mating and boxing; looping, inspection and mending are on the second floor. The general and private offices, box storage, finished goods storage, shipping and receiving rooms are on the first floor. The basement is used chiefly for the storage of raw stock.

The general and private offices and red cross room extend along the whole front of the building and are finished in hardwood, and furnished and decorated in a manner that would do credit to a set of banking offices.

The whole interior of the building, except the offices, is painted with mill white enamel. The walls partitioning the offices from the rest of the first floor are of gypsum block plastered. The portion around the dye house is of the same material with special waterproof plaster and waterproof enamel paint. All stair and elevator enclosures are brick walls and openings are protected by fire doors. The partitions surrounding the lunch rooms and locker rooms on the second floor are of cypress and glass, the cypress being finished natural color.

### Lunch Rooms, Locker Rooms, Smoking Room.

As the majority of the employees are women, special attention was given to the lunch room and locker rooms for these. There is also a smoking room and lunch room for men, which is served from the same kitchen. These rooms are all on the second floor and occupy a space 34 feet by 120 feet. These rooms are all beautifully finished with cypress and the kitchen contains all modern conveniences for preparing and serving meals, such as electric dish washer, steam tables, steam heated plate cupboards, steam heated tea and coffee urns, etc., etc. These rooms are artificially ventilated in such a manner that there is always a strong current of air flowing to the lunch rooms and from the lunch rooms to the kitchen.

### Heating and Ventilating

The building is heated by low pressure steam in wall radiators. These are automatically controlled by thermostats, which hold the temperature at the proper degree. Fresh air is taken from outside and by means of a centrifugal fan drawn through a "Carrier Type" air washer. This air is passed through tempering and heating coils which by means of thermostats control not only its temperature but its humidity. In the cold weather this fresh air is heated to approximately the temperature inside the building. In the hot weather the air is cooled. This ventilating system makes it possible to change the air in the building once in twelve minutes thus making five complete changes per hour and hence the atmosphere inside the building is at all times delightfully clean and fresh and of the proper humidity irrespective of weather conditions. The fan and air washer with control apparatus are situated in the basement.

Special attention is given to the ventilation of the dye house on account of the large amount of steam from the vats. Fresh air is passed over heatng coils and by means of a centrifugal fan, located in a pent house on the roof, this heated air is blown across the dye house. Another fan sucks out the air. It is possible to completely change the air every three minutes and as the fresh air is heated no fog is created.

Four 36 inch disk fans located in pent houses on the roof suck the air from the drying room.

### Boiler House, etc.

After much consideration, it was decided to have the boiler house located under the building. The chief reason for this was to avoid interfering with the contemplated block plan for future buildings. A section of the basement was therefore excavated to such a depth as to allow a ceiling height of about 24 feet. The owners gave particular instructions that the boiler room should be protected from any chance of water seepage through the walls or floor. In constructing the walls, a 12 inch concrete wall was first erected and a 6 inch concrete floor was laid. A sheet of special "membrane" waterproof material was then laid over the floor and inside the walls. An additional 12 inch reinforced concrete wall was then constructed inside the first one. Another 6 inch concrete floor was then laid over the first one. All pipe trenches, furnace pits, etc., were constructed above these concrete floors and the real floor of the boiler room, another 6 inch monolithic concrete slab, was laid three feet above the other floors. The space between the floors was filled with fine crushed stone. A sump pit twelve feet long, five feet wide, eight feet deep is constructed below the boiler room floors. The floors all slope to and drain into this. It merely takes care of any accidental water and is drained by means of an automatic electrically driven sump pump. It can also be drained by a steam siphon.

The present boiler plant consists of two 72 inch by 16 foot return tubular boilers having heating and grate surface sufficient for 150 B. H. P. each. Space is allowed for two additional of similar capacity. They are equipped with "Murphy Automatic Smokeless Furnaces". The construction of these furnaces allows a 24 hour supply of coal to be stored in their hoppers from which it is automatically fed to the fires. The clinker and ash are automatically removed from the fires.

The large underground coal bunkers are outside the building but open to the boiler room and the coal is elevated to the furnace hoppers by means of a hydraulic lift. The ashes and cinders are removed by the same lift.

The boilers are operated at 125 lbs. pressure and live steam is carried to the dye house at this pressure. The pressure is reduced to two lbs. for the heating system and for feeding the tempering and heating coils for the ventilating systems. Another line, carrying a pressure of 6 lbs. feeds the dryers on the fourth floor and certain water heating coils in the dye house. Another line at 10 lbs. pressure serves the apparatus in kitchen and lunch rooms.

The returns (condensed steam) from heating system and all other apparatus are fed by gravity to a receiving tank and automatic, steam driven boiler feed pumps return this to the boilers.

### Hot Water Supply

A pipe coil heater, located in the boiler room, has a capacity of 2000 gallons per hour heating water to 190 deg. F. The exhaust from the boiler feed pumps is turned into the coils of this heater and this is supplemented by steam from the boilers reduced to about one lb. pressure. This heater is connected through circulating pipes with an insulated steel tank in the tower which holds 8000 gallons. The water used is absolutely soft water from a water softening plant as described below and not only supplies the dye house but serves all the lavatories, and is used to feed the boilers. The boilers have been in operation for over twelve months and have never required cleaning and there is no sign of any scale.

### Water Softening Plant

A "Permutit" water softening plant is installed on a raised concrete platform in the boiler room. This has a capacity of 40,000 gallons in ten hours, and as already mentioned two storage tanks are located in the tower. One is for cold soft water and the other for hot soft water and each has a capacity of 8000 gallons. The only chemical used in connection with the softening of water after the "Permutit" plant is once constructed, is common salt. The "Permutit" plant is so located that the charging of the salt is done from a platform at the level of the basement floor.. As already stated the water is absolutely soft and this makes possible the use of delicate operations in dyeing which give the fine and delicate shades of color now demanded in silk hosiery.

### Illuminating System

Although lofty ceilings, white enamelled walls, large window lights on both sides, and extra large spaces between columns insure a maximum of daylight, artificial light is required early mornings and late afternoons during the mid winter months. A very fine quality of artificial light is required and indirect lighting is used throughout. The intensity of the light varies but an idea of the amount and intensity can best be conveyed by stating that all ceilings are provided with light outlets at 14 foot centres both ways. The lights used in these outlets are 300, 400 and 500 watt depending upon the department to be lighted and this figures from 1.5 to 2.5 watts per square foot of floor space. Owing to the light being totally indirect, and having the proper color tone and surface on the walls and ceiling, a very soft diffused light is obtained with no shadows.

### Power and Power Transmission

At the present time all the machinery including fan motors is driven from the hydro system. No overhead shafting is used except in the dye house. Both power and light feeders are controlled by a complete switchboard in the basement, which is equipped with oil circuit breakers, overload and no-load relays, measuring instruments, etc.

### Telephone, Auto Call, Electric Time Clocks, etc.

Electrically operated clocks controlled by a master clock are located in all departments. The in and out time recorders for the employees are located in each department, and these are electrically operated and controlled by the master clock. A system of signal bells which signal the hours for starting and stopping work are also electrically operated and controlled by the master clock.

Telephones are installed in all departments and connect with a private branch exchange board located in the general office. This is all part of the Bell telephone system. An auto-call central is located beside the telephone switchboard. This auto-call allows the switchboard operator to cause signal bells to ring in all parts of the building and as all heads of departments have a definite signal and as there are telephones in all parts of the building any person can at once be reached by telephone.

### Illuminated Flag

Another feature specially called for by the owners for patriotic reasons is an illuminated flag. A large flag is carried on a pole in the centre of the tower and is about 150 feet above the side walk. It is illuminated by eight powerful searchlights concealed behind the parapet walls of the tower. These are so directed that the flag is intensely illuminated no matter in what direction the wind is blowing and as the flag pole is not illuminated the flag appears to be floating in space and on a dark night has a very beautiful effect.

The boiler plant, heating system, ventilating systems, electric wiring for all purposes, electric lighting system, fixtures, plumbing, etc., were all installed by the Bennett & Wright Co. of Toronto. The work was completed in record time and in a most satisfactory manner.

The building structure was constructed by day labor by the Stone & Webster Co. of Boston. These people employed local sub-contractors and local labor.

The Powers system of temperature and humidity control was supplied by Powers Regulator Co. of Canada.

All steam traps, reducing valves, sump pump, boiler feed pumps, radiator valves and traps, pipe coil heater, etc., were supplied by Darling Brothers of Montreal. The boilers and furnaces were installed by G. E. Leonard & Sons, of London. The air washer and ventilating fans were installed by the Canadian Blower & Forge Co., of Kitchener.

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## Activity in the Crushed Stone Business

As indicating the growing activity in the construction field, the Villeray Crushed Stone Company, which is located at 2111 De Lanaudiere St., Montreal, report that they are now operating to capacity, turning out about 150 tons per day from their "Reliance" crusher. This plant is now under the management of E. N. Normandin, who took it over from Gagnon Bros.

Nov 9, 1921

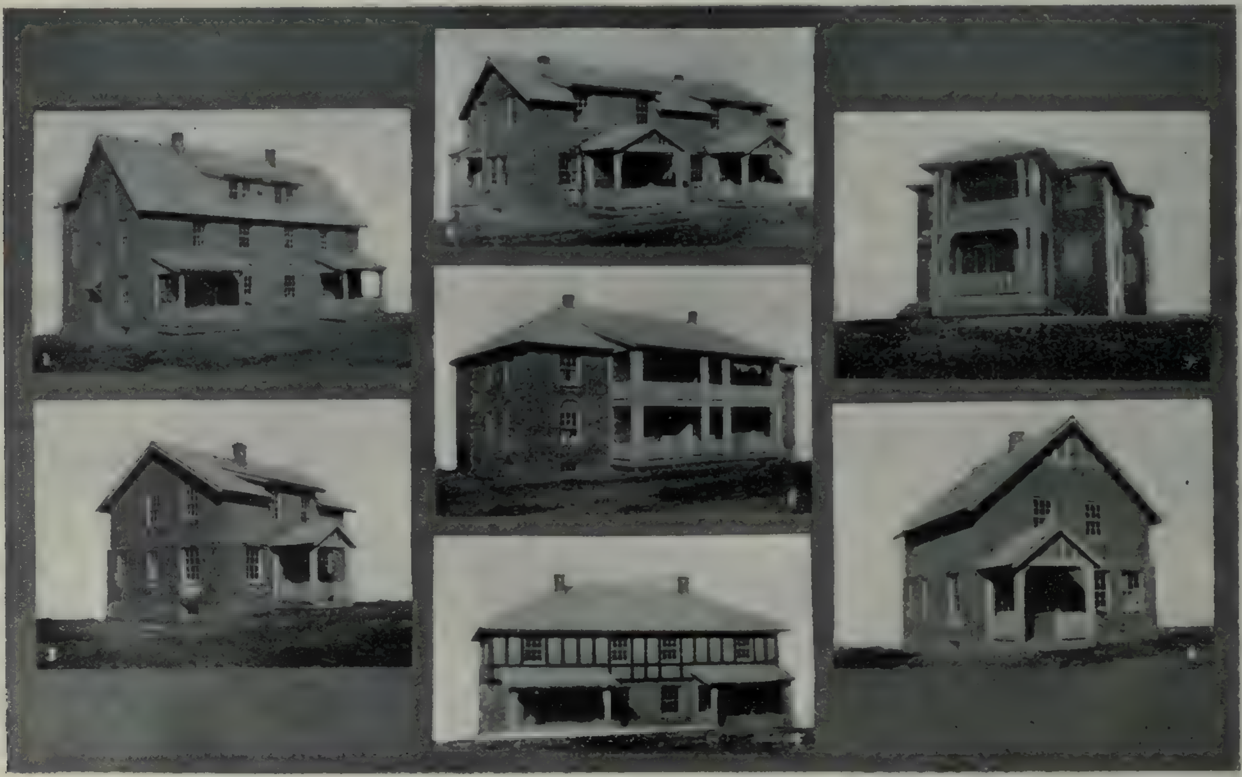
# Housing Development in Sherbrooke

## Model City Built to House the Workers of the Canadian Connecticut Cotton Mills, Whose Recent Extensions Have Aggregated $4,000,000 in Value

By the Contract Record's Sherbrooke, P.Q., correspondent.

The west ward of the city of Sherbrooke, P. Q., can boast of just completing what is the largest industrial development in the Eastern Townships, the Canadian Connecticut Cotton Mills, Ltd., and the Sherbrooke Housing Company being given the credit for that new "village" springing out where not more than twenty months ago it was only meadows.

The impulse given by the war to the cotton trade, and specially to that in rubberised goods found the C. C. C. Mills Ltd., in Sherbrooke, unable to supply the asking for cotton material required in auto tire manufacturing, such a cotton product being a speciality made by this company in Sherbrooke. New addition to the plant already existing being the only solution, it was decided to build a new mill independent from the old one twice extended. The contract was given on a lump sum basis to the E. M. G. Cape Co., Montreal, about the end of January, 1920, and work was started about two weeks later, the work being pushed ahead energetically in spite of the increased cost in freight transportation, the workmen's increasing high wages, the difficulty of getting promised prompt deliveries of construction material, and the embargo on cars from the United States.



Illustrations of several types of houses included in the development of the Sherbrooke Housing Company.

The design and construction of the mill was completely described in the Contract Record of April 27, page 409, and no further reference will be made to it herein.

### Housing

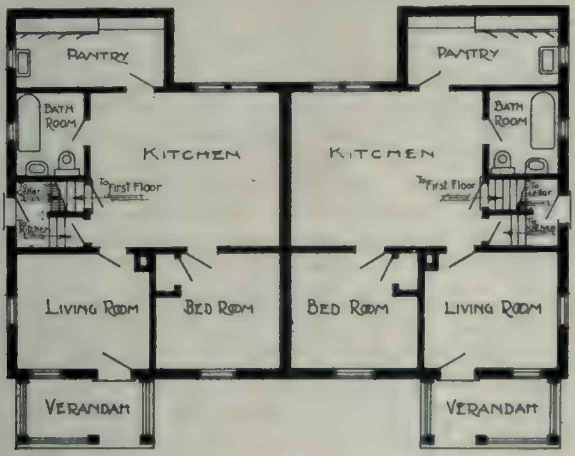
To accommodate workers employed in their mills, some enterprising citizens of Sherbrooke organized the Sherbrooke Housing Company, the C. C. C. Mills being the biggest shareholders. The plans being ready, they had the work commenced in May and carried on simultaneously with the construction of the mill. Fifty-seven houses of eight different types were constructed in all. Seventeen fully detached houses, 33 semi-detached houses, two apartment houses and five two-apartment houses, making a total of 101 dwellings. A proper arrangement of the different types of houses gives that new "City" a pleasing effect and prevents the monotonous looking appearance often seen elsewhere. Reference was made to these houses in the article previously referred to but further details are included herewith, as well as photographs and plans.

Every house is built on a cement foundation with a 6 ft. 6 in. deep cellar; four types of houses are of frame and stucco finish from first floor to roof, while the other four types are of frame and brick veneer. All houses are roofed with grey asbestoslate. The interior arrangement of houses is done on lines to suit the company's experience of the requirements of their employees; the kitchen being the largest room with all other rooms radiating to it. The bath room is on the ground floor and is equipped with modern sanitary fixtures. The flooring is of clear B. C. fir; the trim is of white pine, painted in pearl grey; and walls, ceilings, etc., are plastered with a sand finish. One coat of sizing and two coats of Deccotint of suitable colors are given all over. Every house is equipped with electric lighting and is connected to water mains and sewers.

Model City is quite well situated on a low grade, close to the mills and has Protestant and Roman Catholic churches and schools right opposite its site. Street cars run to the mills. Already the town is a lively place and as the prospects are brightening up in the cotton industry, this new district will soon be filled to capacity.

### Cost of Dwellings

The cost of the houses in the development described above, runs about $5,000 per dwelling. This is an average figure, as the two and four-dwelling tenements run a little less than this, while the self contained single house costs a little over $5,000. It is to be noted that these houses were built during the very peak of prices, before any drop in wages and material costs; this accounts for their high cost.



Ground floor plan of a semi-detached house

The architects for this big enterprise were Messrs. W. E. Tobey and Co. of New Bedford, Mass., for the mills and power house, and Messrs. Ross & MacDonald, of Montreal, for the housing development.

E. G. M. Cape and Co., of Montreal, were the general contractors for both the mills and housing, the total cost amounting to some $4,000,000. The contractor's organization from beginning to end of construction work was under charge of Mr. T. A. Somerville, vice-president of the company; Mr. G. B. Stirling was the company's representative in Sherbrooke.

Sub-contracts were given by general contractors to: Mills—brick, National Brick Co.; cement, Canada Cement Co.; structural steel, Dominion Bridge Co. Ltd., Montreal; steel bridges, MacKinnon Steel Co. Ltd., Sherbrooke; cast iron columns, Canadian Iron Foundries, Ltd., Montreal, John Watson & Son, Ltd., Montreal; elevators, Turnbull Elevator Mfg. Co. Ltd., Toronto; roofing, firedoors, Douglas Bros. Co. Ltd., Montreal; elevators, Turnbull Elevator Mfg. Co. Ltd., Toronto; heating, M. G. Daly & Sons, Waterbury, Conn.; electric wiring, Canadian Comstock Co. Ltd., Montreal; sprinkler system, Globe Automatic Sprinkler Co., Philadelphia; radial chimney, W. Summerhays & Sons, Rochester, N. Y.; ornamental iron, John Watson & Son, Ltd., Montreal; millwork, General Lumber Mfg. Co., Sherbrooke; painting, G. R. Knight, Montreal.

For housing development—millwork, Brompton Lumber & Mfg. Co. Ltd., Bromptonville; plumbing, W. G. Edge, Ltd., Montreal; electric wiring, Wiggett Electric Co. Ltd., Sherbrooke.

## Corrects Report of E. I. C. Meeting

Toronto, Oct. 31st, 1921.

Editor, Contract Record.
Dear Sir,—

In reading the report of the discussion which took place recently at the Toronto Branch of the E. I. C. in connection with the waterproofing of roadway surfaces, I notice that some of my remarks were misunderstood.

The report states that I strongly advocated the annual waterproofing of roadways by the application of Tarvia, etc, etc, and submitted figures in support of this statement.

What I did say was that I had used with success many of the road surface binders in common use, among them being the various grades of Tarvia and asphaltic oils, but found that to secure the greatest benefit by their use, they had to be applied annually or oftener.

I further remarked that the question of cost entered largely into the preservation and conservation of macadam surfaces and suggested that it would be more economical to apply to a macadam road, providing the foundation was satisfactory, a two inch layer of bituminous surface of the hot mix type the figures given being in support of this statement.

I would be very glad if you would kindly make this explanation in your next issue.

Yours very truly,
L. M. Jones

## Gary Motor Truck Co. To Operate On Large Scale

The Gary Motor Truck Corporation of Canada, has been incorporated to manufacture Gary motor trucks. This company has a capital of $4,500,000 and is now operating in Toronto, having purchased the plant of the Chase Tractor Company, on Atlantic Avenue, of that city, which comprises four acres of land and buildings to the extent of 75,000 sq. ft. of floor space. While all motor parts will not be manufactured in Canada immediately, as many as possible will be made here at once. The motors are Buda type; the transmission, Fuller & Brown-Lipe and the axles are Timken.

It is claimed for this company that it will have the largest truck and tractor plant in the British Empire. All export business to foreign countries will be taken care of from the Toronto factory. The company will also go after municipal business and in the very near future will go into the production of fire apparatus, special bus cars, street flushers, etc.

The management and board of directors includes some well known names. The president and general manager is Theodore B. W. Zumstein, who has been vice-president of the American Gary Company. The sales department is under A. S. Holleyhead, who is also a director of the company. The vice-president is R. J. Cluff, president of the Galt Brass Co. and vice-president of the Port Hope Sanitary Company. The board of directors includes Senator Curry, who is chairman of the board of directors of the Canadian Car and Foundry Co.; Roy M. Wolvin, president of the Dominion Iron & Steel Co.; W. J. Cluff, president of Cluff Bros. Co., the National Electric Products Co. and the Canada Pipe & Steel Co., and James Whelan, vice-president, Whelan Pulp & Paper Company.

# Central Mixing for Concrete Roads

## A Synopsis of Two Years' Experience with Wet Batch Haulage of Concrete from a Central Plant—Scheme Has Met with General Success

In an article in Engineering News-Record by C. S. Hill there are brought together the conclusions of about two years' experience in concrete road construction by central mixing and wet-batch haulage. These conclusions are based on studies of many central mixing plant operations supplemented by opinions and data from highway engineers and contractors who have employed central mixing. The studies have been largely confined to the four states, Illinois, Wisconsin, Iowa and Minnesota, where the new practice is most common. They are of particular interest in view of the fact that outside of this group of states wet batch haulage has gained little favor and is forbidden by some highway departments.

Except for occasional street-paving operations, the practice of central mixing in these states began in 1919. In that year a few plants were installed, almost experimentally by contractors, and approved by highway officials, with the mental reservation that the product should be rigidly scrutinized. Their operation disclosed no serious objections; in fact they made converts to central mixing of many contractors and highway officials. Two year's further experience has cooled the first enthsiasm and the engineer can now review the results in fair perspective.

General conclusions may be drawn as follows:

1. Where conditions favor their use, central mixing and wet-batch haulage are an economical method of concrete road construction.
2. The product has been accepted generally as meeting the requirements of prevailing specifications but it is considered necessary to keep careful watch of its quality.
3. The proportions and consistency of mixture which best endure transportation require investigation and a quantitative means of determining consistency is needed.
4. Mixing plant and hauling practice has not been worked out and requires improvement in plan, coordination and details.

Of these conclusions the second and third are obviously the constants of the central mixing problem. Suitability of the method and, to a smaller extent, the plant equipment are determined by local conditions, but quality of product and means of ensuring this quality are invariable requirements. They determine the service value of the road while the other two factors only affect its construction costs. Discussion of product is, therefore, of most immediate importance and it separates into a consideration of (1) segregation, and (2) proportions and consistency.

### Segregation

Segregation is a danger which obstructs all ways of transporting wet concrete. It is not peculiar to road construction. It calls for care in chuting the material a few scores of feet and it is a positive danger in carrying the material greater distances in trucks, cars and other containers. Therefore the road engineer has in segregation the common problem of all concrete construction but it is made more difficult by the greater distances which the material has to be transported. This thought is emphasized because there has been a disposition to magnify segregation into a danger peculiar to concrete road construction by central mixing.

When segregation occurs during transportation the only positive remedy is remixing.. If, however the separation of aggregates and liquid mortar is not excessive, methods of placing may remedy the condition sufficiently to overcome practical objections against the concrete being used. This is an important fact in concrete road construction. The placing of the concrete in a thin layer open to view permits minor conditions of segregation to be remedied in spreading and the use of a finishing machine, a practical necessity with concrete dry enough to be hauled a long distance, still further helps by its violent churning action to secure uniformity.

Concrete is hauled longer distances—one to three miles—in road construction than in other operations. It has been hauled five and six miles but there is reasonable doubt whether a longer haul than 2½ to 3 miles is economical if a considerable quantity has to be handled. Some engineers set the economic limit at a 40-min. haul. Because of the distance hauled, nearly always a jolting trip in trucks over rough roads, segregation is particularly likely. Its extent is determined by the following factors:

1. Time of haul and character of the road: the longer the batch is travelling and the more jolting it receives, the greater is the separation of the aggregates and the more firmly they are compacted in the bottom of the container.
2. Character of aggregate: a gravel mixture segregates more easily than does a broken stone mixture.
3. Consistency: segregation is least in dry mixtures.
4. Proportions: proportions which give a well-graded and, therefore, a dense mixture, reduce segregation.

### Consistency and Proportions

In actual road construction other factors than segregation control the character of the aggregate, the consistency of the mixture and its proportions. First, the aggregate which is economically available has to be used. Second, the proportions in most specifications are limited to 1:1½:3 and 1:2:4. More variation in consistency is practiced, but stiff mixtures are most common. Practically, the difficulty of placing and furnishing a dry mixture sets a constructional-economic limit to dryness for the mere purpose of decreasing segregation. With these general facts in mind, the results of experience with respect to consistency and proportions for wet-batch haulage can be stated as follows:

1. A dry mixture is best for wet-batch haulage. Dry concrete is a relative term but there is for concrete a certain consistency which endures transportation without serious segregation. A quantitative definition of this consistency has not been determined. A descriptive definition is about as follows: The concrete should not flatten out when dumped from the mixer into the truck but should stand slightly heaped, possibly 8 to 10 in., in the ordinary four-bag-batch container, and flatten out only after the truck has traveled several hundred feet. This consistency gives about a 1-in. slump, in the regulation test, for an ordinary gravel mixture. It makes about as stiff a concrete as is workable, a concrete too stiff for hand finishing and requiring a finishing machine.

The standard slump test is not sufficient for determining the safe consistency of mixture for wet-batch haulage. It is indicative and should be retained but with skilled foreman and inspectors a closer check can be held on the mixture by its appearance as it is discharged from the mixer or from the truck at the end of the haul. The slump of a gravel concrete is different than that of a stone concrete. Also, the gradation of the mixture and the size of the aggregate effect the slump. Therefore, the slump of a concrete is not a close enough measure to detect the narrow zone of variation in wetness between a mixture which will segregate and one which will not. A few quarts of water will make a safe mixture unsafe in respect to segregation.

2. The proportions of the mixture are significant in wet-batch haulage only as they affect gradation. Well-graded materials, that is, a dense mixture, decrease the tendency to segregate. The opinion sometimes expressed by hauling crews that a 1:2:4, or some other, mixture cannot be hauled wet, is based on misapprehension. If a mixture is well graded it makes little difference in its tendency to segregate what its numerical proportions may be. In Iowa, where the use of pit-run gravel has been highly perfected, proportions as odd as 1:2½:1 have been hauled wet.

### Construction Difficulties

Wet-batch haulage involves construction difficulties which do not exist when the mixing is done on the road. More weight has to be hauled and more work is required to place and finish the concrete.

With mixtures showing a 1 to 2-in. slump, trouble has been experienced generally in securing a dump body which will discharge all its contents. On short hauls and with ideal conditions the mixed concrete will dump without adhering, however, the major part of the time it is necessary to pick or dig a portion from the truck regardless of the type of body used. The packed material when loosened requires more work to secure uniformity in placing than where the concrete is distributed directly from the mixer onto the subgrade. The water in the mixed concrete of course, adds to the weight hauled compared with dry batch haulage.

A concrete dry enough to be hauled wet ordinarily cannot be finished economically by hand. With finishing machines little difficulty is experienced. During extremely hot weather it is necessary to wet the sand as well as the stone or gravel sometime in advance of the mixing. Enough water to saturate the sand is required. If it is not soaked the material will absorb water while the batch is being hauled and there will be trouble in dumping and finishing. Under normal conditions little difficulty is experienced in machine finishing concrete which has been hauled three or four miles, but in very hot weather the concrete is sometimes too stiff, after being hauled several miles, to be finished easily.

Roads built of concrete hauled from central mixing plants have not been long enough in service to indicate conclusively whether they are inferior or superior to roads built of concrete mixed on the grade.

Observation generally does not indicate that there is any difference in the strength of the concrete. This conclusion is supported by tests at three months of field specimens from a number of concrete road jobs in Iowa. On five jobs carried on in 1920 using 1:2:3½ sand and gravel-concrete, the mixing was done on the road for three and at a central plant, with wet batch haulage, for two, and the results of crushing tests were as follows:

| | |
|---|---|
| Average of 19 specimens, road mix .... | 3,660 lb. |
| Average of 24 specimens, road mix .... | 3,870 lb. |
| Average of 30 specimens, road mix .... | 3,990 lb. |
| Average of 21 specimens, central mix .. | 3,600 lb. |
| Average of 26 specimens, central mix .. | 3,460 lb. |

There is radical difference of opinion respecting the uniformity of the concrete secured when central mixing and wet-batch haulage are employed. The extreme opinions may be summarized as follows:

1. In no case has it been possible to secure a uniform concrete when wet concrete was hauled. It is believed that unless the concrete is remixed after reaching the road a non-uniform pavement will result.

2. The concrete which is delivered by wet-batch haulage provides a satisfactory road.

### Conclusion

In three of the four states whose experience has been reviewed central mixing with wet-batch haulage is considered a satisfactory construction method, when the work is carefully directed. In the fourth state inability to secure uniformity of product has raised the question whether the method should not be discontinued.

The complete success of wet-batch haulage required that some means of controlling segregation with more precision than is now practicable must be developed.

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## Pulverized Fuel Department Acquired

Quigley Furnace Specialties Co., Inc., New York, announce that their pulverized fuel department has been acquired by the Hardinge Company, 120 Broadway, New York. There will be no change in the method of conducting the business, as the organization of the Quigley Engineering Department has been taken over practically intact. The Quigley Company will still carry on their refractory specialties business, which includes the manufacture and sale of "Hytempite," (high temperature cement), "Insulbrix" (insulating refractory brick) and "Insuline" products.

# Maximum Joist and Rafter Spans

## Convenient Tables Facilitate the Determination of Lengths of Timbers for Load Conditions Encountered in Ordinary Construction

By L. P. KEITH, Technical and Research Department, National Lumber Manufacturers' Association

The group of tables herewith has been prepared to facilitate design by furnishing in convenient and comprehensive form some adequate means of determining the lengths of joist and rafter spans for conditions encountered in ordinary construction. The fact that the weights of flooring, plaster, roof coverings and other items necessary in any computations having to do with joist and rafter lengths are not always at hand when computations of this kind have to be made, often leads to lack of uniformity not only in the same office, but on the same job.

Such being the condition, it has been our purpose to offer in readily accessible form information with necessary supporting data dealing with this general subject. Knowing the kind of timber, the proper column to refer to for span length can quickly be determined by examining the table of allowable working stresses which appears below.

The computations to determine the strength of the various members in these tables are based on the actual and not the nominal sizes of timbers.

The tables which follow explain themselves and the significance of the figures contained therein need no further interpretation.

### Average Weights of Various Materials

(For use in determining Dead Loads. These weights were used in obtaining span lengths which appear in these tables.)

#### Joists

| Nominal size | Actual size | Wt. per lineal foot |
|---|---|---|
| 2 x 4 | 1⅝ x 3⅝ | 1.6 lbs. |
| 2 x 6 | 1⅝ x 5⅝ | 2.5 lbs. |
| 2 x 8 | 1⅝ x 7½ | 3.4 lbs. |
| 2 x 10 | 1⅝ x 9½ | 4.3 lbs. |
| 2 x 12 | 1⅝ x 11½ | 5.2 lbs. |
| 3 x 12 | 2⅝ x 11½ | 8.8 lbs. |
| 2 x 14 | 1⅝ x 13½ | 6.6 lbs. |
| 3 x 14 | 2⅝ x 13½ | 10.3 lbs. |

| | | |
|---|---|---|
| Finished floor | 2.5 | lbs. per sq. ft. |
| Rough floor | 2.5 | lbs. per sq. ft. |
| Sheathing | 2.5 | lbs. per sq. ft. |
| Plaster | 10.0 | lbs. per sq. ft. |

#### Roofing, Group 1

| | | |
|---|---|---|
| Shingles | 2.5 | lbs. per sq. ft. |
| Copper sheets | 1.5 | lbs. per sq. ft. |
| Copper tile | 1.75 | lbs. per sq. ft. |
| Three-ply ready roofing | 1.00 | lbs. per sq. ft. |

#### Roofing, Group 2

| | | |
|---|---|---|
| Slate 3/16 inch | 7¼ | lbs. per sq. ft. |
| Roman tile, new style, 1 part | 8 | lbs. per sq. ft. |
| Spanish tile, new style, 1 part | 8 | lbs. per sq. ft. |
| Ludowici tile | 8 | lbs. per sq. ft. |

**Allowable Unit Stresses for Structural Timber**

**(Pounds per square inch)**

For Dry Locations Only

| Species of Timber | BENDING | | COMPRESSION | |
|---|---|---|---|---|
| | Stress in Extreme Fibre Lbs. sq. in. | Horizontal Shear Stress Lbs. sq. in. | Parallel to grain "Short Columns" Lbs. sq. in. | Perpendicular to grain Lbs. sq. in. |
| Douglas Fir— | | | | |
| Dense Grade | 1600 | 100 | 1200 | 350 |
| Sound Grade | 1300 | 90 | 1000 | 300 |
| Hemlock, Eastern | 1000 | 70 | 700 | 300 |
| Hemlock, Western | 1300 | 75 | 900 | 300 |
| Oak | 1400 | 125 | 1000 | 500 |
| Pine, Eastern White | 900 | 85 | 750 | 250 |
| Pine, Norway | 1100 | 85 | 800 | 300 |
| Pine, Sou. Yellow— | | | | |
| Dense Grade | 1600 | 125 | 1200 | 350 |
| Sound Grade | 1300 | 105 | 1000 | 300 |
| Spruce | 1100 | 85 | 800 | 250 |
| Tamarack | 1200 | 95 | 1000 | 300 |

**Maximum Spans for Ceiling Joists and Attic Floor Joists, Uniformly Loaded**

| Size of Joists (Nominal) in inches | Spacing of Joists Center to Center in inches | Maximum Allowable Lengths Between Supports — Determined by Deflection (For Extreme Fibre Stress of 900 lbs. per sq. in. or more in Bending.) | |
|---|---|---|---|
| | | Ceiling Joists | Attic Floor Joists |
| | | Ft. Ins | Ft. Ins. |
| 2 x 4 | 12 | 9 — 11 | |
| | 16 | 9 — 2 | |
| 2 x 6 | 12 | 15 — 1 | 10 — 9 |
| | 16 | 13 — 11 | 9 — 9 |
| 2 x 8 | 12 | 19 — 8 | 14 — 2 |
| | 16 | 18 — 3 | 13 — 0 |
| 2 x 10 | 12 | 24 — 4 | 17 — 10 |
| | 16 | 22 — 8 | 16 — 4 |
| 2 x 12 | 12 | | 21 — 4 |
| | 16 | | 19 — 8 |

**Note!** The lengths are based on:
Maximum allowable deflection of 1/360 of span length.
Modulus of Elasticity of 1,200,000 lbs. per sq. in.
Ceiling Joists:
Dead Load—Weight of plaster and joists.
Attic Floor Joists:
Dead Load—Weight of joists.
Plastering 10 lbs. per sq. ft.
Rough floor 2.5 lbs. per sq. ft.
Live Load—20 lbs. per sq. ft.

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## Opposes One-Material Highways

Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, deplores the tendency that has been developing to pass legislation governing conditions of bond issues and specifying one type of material to be used in highway construction. Such a course, he says, is unfortunate and costly. Mr. MacDonald urges open competition for all materials and more careful consideration of cost and local conditions affecting construction before the type of pavement is determined upon.

## Maximum Allowable Spans for Floor Joists, Uniformly Loaded

| Size of Joists (Nominal) in inches | Spacing of Joists, Center to Center in inches | Maximum Allowable Lengths Between Supports | | | |
|---|---|---|---|---|---|
| | | Live Load 40 lbs. Per Sq. Ft. of Floor Area | | Live Load 60 lbs. Per Sq. Ft. of Floor Area | |
| | | Determined by Bending | Determined by Deflection | Determined by Bending | Determined by Deflection |
| | | For Extreme Fibre Stress of 900 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,000 lbs. per sq. in. or more, in Bending, use this column. | For Extreme Fibre Stress of 900 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,000 lbs. per sq. in. or more, in Bending, use this column. |
| | | Ft. — Ins. | Ft. — Ins. | Ft. — Ins. | Ft. — Ins. |
| 2 x 6 | 12 | 9 — 1 | 9 — 1 | 8 — 2 | 8 — 3 |
| | 16 | 8 — 3 | 8 — 3 | 7 — 3 | 7 — 7 |
| 2 x 8 | 12 | 12 — 0 | 12 — 0 | 10 — 9 | 10 — 11 |
| | 16 | 10 — 11 | 11 — 0 | 9 — 8 | 10 — 2 |
| 2 x 10 | 12 | 15 — 2 | 15 — 2 | 13 — 8 | 13 — 9 |
| | 16 | 13 — 9 | 13 — 10 | 12 — 2 | 12 — 9 |
| 2 x 12 | 12 | 18 — 3 | 18 — 3 | 16 — 5 | 16 — 7 |
| | 16 | 16 — 8 | 16 — 8 | 14 — 8 | 15 — 5 |
| 3 x 12 | 12 | 21 — 4 | 21 — 4 | 19 — 6 | 19 — 6 |
| | 16 | 19 — 7 | 19 — 7 | 18 — 1 | 18 — 1 |
| 2 x 14 | 12 | 21 — 9 | 21 — 9 | 19 — 9 | 19 — 10 |
| | 16 | 20 — 0 | 20 — 0 | 17 — 9 | 18 — 5 |
| 3 x 14 | 12 | 24 — 10 | 24 — 10 | 22 — 9 | 22 — 9 |
| | 16 | 22 — 10 | 22 — 10 | 21 — 2 | 21 — 2 |

**Note:** The lengths are based on:
Maximum allowable deflection of 1/360 of span length.
Modulus of Elasticity of 1,200,000 lbs. per sq. in.
Dead Load—Weight of joist.
Weight of plaster ceiling 10 lbs. per sq. ft.
Double thickness flooring 5 lbs. per sq. ft.
Live Load—As indicated.

## Maximum Spans for Roof Joists, Uniformly Loaded

### Inclination of 1/5 pitch and less

### Roof Covering 7 lbs. per sq. ft.—Five ply felt and gravel

| Size of Joists. (Nominal) in inches | Spacing of Joists, Center to Center in ins. | Maximum Allowable Lengths Between Supports | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Determined by Deflection of 1/360 of Span | Determined by Bending | | | | | |
| | | | For Extreme Fibre Stress of 900 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,000 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,100 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,200 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,300 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,600 lbs. per sq. in. in Bending, use this column. |
| | | Ft. — Ins. | Ft. — Ins. | Ft. — Ins. | Ft. — Ins. | Ft. — Ins. | Ft. — Ins. | Ft. — Ins. |
| 2 x 6 | 12 | 8 — 10 | 9 — 1 | 9 — 7 | 10 — 1 | 10 — 6 | 11 — 0 | 12 — 2 |
| | 16 | 8 — 1 | 7 — 11 | 8 — 4 | 8 — 9 | 9 — 2 | 9 — 6 | 10 — 7 |
| 2 x 8 | 12 | 11 — 9 | 12 — 1 | 12 — 8 | 13 — 4 | 13 — 11 | 14 — 6 | 16 — 1 |
| | 16 | 10 — 9 | 10 — 6 | 11 — 1 | 11 — 8 | 12 — 2 | 12 — 8 | 14 — 0 |
| 2 x 10 | 12 | 14 — 10 | 15 — 2 | 16 — 0 | 16 — 9 | 17 — 6 | 18 — 3 | 20 — 3 |
| | 16 | 13 — 6 | 13 — 3 | 13 — 11 | 14 — 8 | 15 — 3 | 15 — 11 | 17 — 7 |
| 2 x 12 | 12 | 17 — 10 | 18 — 3 | 19 — 3 | 20 — 2 | 21 — 1 | 21 — 11 | 24 — 4 |
| | 16 | 16 — 4 | 15 — 11 | 16 — 10 | 17 — 8 | 18 — 5 | 19 — 2 | 21 — 3 |
| 3 x 12 | 12 | 20 — 8 | 23 — 1 | 24 — 4 | 25 — 6 | 26 — 7 | 27 — 9 | 30 — 9 |
| | 16 | 19 — 2 | 20 — 3 | 21 — 5 | 22 — 6 | 23 — 5 | 24 — 5 | 27 — 1 |
| 2 x 14 | 12 | 21 — 3 | 22 — 0 | 23 — 2 | 24 — 4 | 25 — 5 | 26 — 5 | 29 — 4 |
| | 16 | 19 — 6 | 19 — 4 | 20 — 5 | 21 — 5 | 22 — 4 | 23 — 3 | 25 — 10 |
| 3 x 14 | 12 | 24 — 4 | 26 — 10 | 28 — 3 | 29 — 8 | 31 — 0 | 32 — 3 | 35 — 9 |
| | 16 | 22 — 7 | 23 — 8 | 24 — 11 | 26 — 2 | 27 — 4 | 28 — 5 | 31 — 7 |

**Note:** The lengths are based on:
Modulus of Elasticity of 1,200,000 lbs. per sq. in.
Dead Load—Weight of joist.
Sheathing 2.5 lbs. per sq. ft.
Covering 7 lbs. per sq. ft.
Live Load—50 lbs. per sq. ft. of roof surface considered as acting normal to the roof surface.

## Maximum Spans for Roof Rafters, Uniformly Loaded

### Inclination of 1/5 pitch to 1/2 pitch

### Roof Covering 2.5 Lbs. per sq. ft. (Group I.)

| Size of Rafters, (Nominal) in inches | Spacing of Rafters, Center to Center in ins. | Maximum Allowable Lengths Between Supports | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Determined by Deflection of 1/360 of Span | Determined by Bending | | | | | |
| | | | For Extreme Fibre Stress of 900 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,000 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,100 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,200 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,300 lbs. per sq. in. in Bending, use this column. | For Extreme Fibre Stress of 1,600 lbs. per sq. in. in Bending, use this column. |
| | | Ft. — Ins. | Ft. — Ins. | Ft. — Ins. | Ft — Ins. | Ft. — Ins. | Ft. — Ins. | Ft. — Ins. |
| 2 x 4 | 12 | 6 — 10 | 7 — 8 | 8 — 1 | 8 — 6 | 8 — 10 | 9 — 2 | 10 — 2 |
| | 16 | 6 — 3 | 6 — 9 | 7 — 1 | 7 — 5 | 7 — 9 | 8 — 1 | 9 — 0 |
| 2 x 6 | 12 | 10 — 6 | 11 — 9 | 12 — 4 | 12 — 11 | 13 — 6 | 14 — 1 | 15 — 8 |
| | 16 | 9 — 7 | 10 — 3 | 10 — 9 | 11 — 4 | 11 — 10 | 12 — 4 | 13 — 8 |
| 2 x 8 | 12 | 13 — 10 | 15 — 5 | 16 — 3 | 17 — 1 | 17 — 10 | 18 — 6 | 20 — 7 |
| | 16 | 12 — 8 | 13 — 6 | 14 — 3 | 14 — 11 | 15 — 7 | 16 — 2 | 18 — 0 |
| 2 x 10 | 12 | 17 — 5 | 19 — 4 | 20 — 4 | 21 — 4 | 22 — 4 | 23 — 2 | 25 — 9 |
| | 16 | 15 — 11 | 16 — 11 | 17 — 10 | 18 — 9 | 19 — 7 | 20 — 4 | 22 — 7 |

**Note:** The lengths are based on:
Modulus of Elasticity of 1,200,000 lbs. per sq. in.
Dead Load—Weight of rafter.
Sheathing 2.5 lbs. per sq. ft.
Covering 2.5 lbs. per sq. ft.
Live Load—30 lbs. per sq. ft. of roof surface considered as acting normal to the roof surface.

## Maximum Spans for Roof Rafters, Uniformly Loaded

### Inclination of 1/5 pitch to 1/2 pitch

### Roof Covering 8 Lbs. per sq. ft. (Group II.)

| Size of Rafters, (Nominal) in inches | Spacing of Rafters, Center to Center in ins. | Maximum Allowable Lengths Between Supports | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Determined by Deflection of 1/360 of Span | Determined by Bending | | | | | |
| | | | For Extreme Fibre Stress of 900 lbs per sq in in Bending, use this column. | For Extreme Fibre Stress of 1,000 lbs. per sq. in in Bending, use this column. | For Extreme Fibre Stress of 1,100 lbs per sq in. in Bending, use this column. | For Extreme Fibre Stress of 1,200 lbs per sq in in Bending, use this column. | For Extreme Fibre Stress of 1,300 lbs. per sq in in Bending, use this column | For Extreme Fibre Stress of 1,600 lbs. per sq in in Bending, use this column. |
| | | Ft. — Ins. | Ft. — Ins. | Ft. — Ins. | Ft — Ins. | Ft. — Ins. | Ft — Ins. | Ft. — Ins |
| 2 x 4 | 12 | 6 — 6 | 7 — 2 | 7 — 6 | 7 — 11 | 8 — 3 | 8 — 7 | 9 — 6 |
| | 16 | 5 — 11 | 6 — 2 | 6 — 6 | 6 — 11 | 7 — 2 | 7 — 6 | 8 — 3 |
| 2 x 6 | 12 | 10 — 0 | 10 — 11 | 11 — 6 | 12 — 1 | 12 — 8 | 13 — 2 | 14 — 7 |
| | 16 | 9 — 1 | 9 — 7 | 10 — 1 | 10 — 7 | 11 — 0 | 11 — 6 | 12 — 9 |
| 2 x 8 | 12 | 13 — 3 | 14 — 5 | 15 — 3 | 16 — 0 | 16 — 8 | 17 — 4 | 19 — 3 |
| | 16 | 12 — 1 | 12 — 8 | 13 — 3 | 13 — 11 | 14 — 7 | 15 — 2 | 16 — 10 |
| 2 x 10 | 12 | 16 — 8 | 18 — 1 | 19 — 1 | 20 — 0 | 20 — 10 | 21 — 9 | 24 — 1 |
| | 16 | 15 — 3 | 15 — 10 | 16 — 8 | 17 — 6 | 18 — 4 | 19 — 1 | 21 — 2 |

**Note:** The lengths are based on
Modulus of Elasticity of 1,200,000 lbs. per sq. in.
Dead Load—Weight of rafter
Covering 8 lbs per sq. ft.
Sheathing 2.5 lbs. per sq. ft.
Live Load—30 lbs per sq ft of roof surface considered as acting normal to the roof surface

# The Concrete Roads of This Continent as Viewed by a Britisher

## Prominent English Engineer, After Survey of Highway Construction in Canada and the United States Concludes That Concrete Will Satisfactorily Meet Old Country Conditions.

As mentioned in our journal some time ago, this country was being visited by one of the best-known British engineers, Alfred Dryland, county engineer and surveyor of Middlesex, who came here to study our road conditions and highway construction methods. Mr. Dryland took an extensive tour of certain parts of Canada and the United States, noting particularly the practice on this side with regard to concrete roads. His observations have recently been published in our British contemporary, "The Surveyor," and as it is interesting to have an "outsider's" opinion of our accomplishments, some abstracts from this article are reprinted herewith. After acknowledging the courtesy and hospitality of engineers and officials who helped him in his tour and outlining the general administration of highway affairs on this continent, he proceeds:

I gathered that over huge areas there was very little hard stone available. There is "trap rock," corresponding approximately to basalt, some limestone, of which much is of a very inferior quality, and more frequently there are gravel deposits of a pebbly kind, derived largely from water-worn limestone, but containing a proportion of silica pebbles. These, with a "chert rock" in the State of Illinois, and the gravel and boulders derived from river beds and from the surface of the land, were the only roadmaking material I saw, and over large areas even the poorest of these had to be hauled by railway for long distances. It was therefore, I think, a very natural process of reasoning in the mind of the engineer that he could, by utilizing Portland cement, render most serviceable his inadequate and somewhat inferior material by converting it into concrete.

I gather the earliest experiments in concrete roads on a large scale were carried out by Highway Commissioner Hines, a very able public man in Wayne County, which surrounds the large and busy city of Detroit, in the State of Michigan. It is natural, also, this neighborhood should have been a pioneer, as Detroit may indeed be termed a motor-car city.

In 1909 Commissioner Hines laid several miles of concrete road, some 9 ft. and some 10 ft. wide, and it was doubtless a delight to the city car owners to be able to have a speed up on a country road with a firm and a good travelable surface all the year round. From this and other similar small beginnings in various parts of the States the leaven has spread, until this day, when it is calculated there are at least 20,000 miles of concrete roads within the confines of the United States, and a very considerable mileage also in Canada. The State of Pennsylvania is constructing this year 650 miles of road, of which 600 are concrete; Wisconsin and Illinois each hope to construct nearly 400 miles in the same manner, and every State I visited has a large program of similar work. It is undoubtedly a fact that the concrete road has given and is giving extremely useful service and is widely appreciated by the travelling public.

It may be useful if I explain here, before proceeding to detail in regard to concrete roads, the forms of road surfacing prevalent in Canada and the States. In the cities there is quite a small amount of both wood paving and granite setts, the latter mostly on tramways, but the general pavement is undoubtedly sheet asphalt, most frequently a two-course pavement of 1½ in. binder and 1½ in. topping, or occasionally one coat of 3-in. "Topeca" mixture, but in almost every case laid on 6-in. concrete, or 10 in. in the recent work in the heavily-trafficked streets of the larger cities. There is a good deal of brick pavement also in the streets and suburbs of the cities, and it is the usual pavement found in the smaller cities. In some states in the cities and outside one will find long stretches of stone-filled asphalt pavement, known there as "Warrenite." This is sometimes laid on macadam foundations, but usually on 6-in. concrete, and the latter is often brought up to form a retaining kerb on the country roads. There are quite a few roads in some states which have been macadamized and the surface treated with asphalt oil or tar; these materials are often used alternatively, the latter being the material used in the first treatment because of its great powers of penetration and adhesion. These roads, where properly maintained, afford quite good surfaces. Some of the macadam, however, is only 9 ft. wide, with gravel or earth shoulders. Another class is the gravelled road, which has usually a loose, pebbly surface, and the method of maintenance is to "drag" it after every rain so as to even up the inequalities.

It sounds rather primitive, but it is surprising how well these roads travel and what satisfaction they afford. There is no attempt at rolling. The new gravel is deposited along the centre and spread by horse-drawn drags, and the consolidation is left to the traffic.

### Concrete-Surfaced Roads

I mentioned in an earlier paragraph that the first efforts in concrete construction were mostly limited to narraw widths, such as 9 ft. or 10 ft., but many of these are already being widened, and standards now run 15 ft., 18 ft., 20 ft., occasionally 24 ft. and even 30 ft.

Thickness.—Early pavements were laid as thin as 4 in. at the sides and 6 in. at the centre, but experience proved this to be inadequate, and the minimum is now generally 6 in. at the sides and 8 in. at the centre, some 7 in, sides to 9 in, centre, others 8 in. to 9½ in., or 8 in. throughout lightly reinforced at 2 in. below the surface.

Mix.—This varies within narrow limits in different states, but is generally 1 : 1 : 3½, or 1 : 2 : 3, occasionally

1: 2: 4. The governing factors are taken to be a rich mortar and sufficient of it to fill the voids.

Aggregate.—Broken trap rock, limestone or gravel. The specifications vary, some places permitting a maximum size passing a 3-in. ring, but generally 2¼ in. is the upward limit, and is required to be graded down. Sands are considered of great importance, both in grading and as to freedom from injurious chemicals, particularly from the alkali. Very fine sands are rejected, as they tend to form a fine skin of unstable mortar on the surface.

Preparation of sub-grade.—This is now receiving a good deal of attention, as it is realised it has an important bearing upon the future behaviour of the concrete road. Efforts are made to get a well-drained, evenly-consolidated bed for the concrete, although it generally consists of the natural soil, or at best a thin coat of old macadam derived from the previous narrow metalled road surface.

Horse ploughs, shovels, scoops, and even steam shovels are used in grading and preparing the road bed, which, when formed to proper camber, is well rolled. Steel side forms are put up well in advance of the concrete, and along these a heavy-grade template is run to ensure the proper depth of concrete is available.

No verges are provided. The "shoulders" slope sharply away to the side ditches. Generally they are earth, but are sometimes gravelled, and occasionally macadamized. Traffic often has to use these margins for passing purposes and it is quite common to see a drop of 2 in. or 3 in. at the edge of the road pavement.

Concrete laying.—The outfits for this purpose are usually very complete. Large mixers are the rule, in some cases a capacity of 2 cube yds., but more generally capable of mixing 1 cube yd. of concrete. The mixers are usually on caterpillar wheels, and run in the centre of the road. The feeding is most frequently from light railway gauge boxes run at the side, but occasionally from Ford tipping wagons, or ordinary end-tipping lorries, divided to carry and discharge separately three batches. the mixing is specified to be 14 or 16 revolutions with a time limit of 1 minute, and as the organization for rapid feeding is very complete the process is a speedy one. One outfit with a 2-yd. mixer in Illinois recently laid a mile of 18-ft. road 8 in. thick in seven working days; with the smaller plants 200 yd. of 18-ft. road 8 in. thick is considered a good 10-hour day's work.

Almost every outfit I saw, probably twenty of them, has a machine tamper of the Lakewood or Austin type with a belt finisher. If care is exercised in watching that the tamper is well fed in the low places, a true camber is obtained and a very smooth finish. The concrete is used only sufficiently wet to tamp up to a good surface.

Covering.—As soon as the tamping machine has finished its work if the sun is powerful, shade is provided by canvas awnings on frames running on wheels on the side forms. As soon as the surface has set earth is spread about 2-in. thick, or alternatively hay and straw, and this is kept moist for fourteen days, when the covering is removed and the surface exposed for fourteen days before being submitted to traffic.

Joints.—Practice varies a great deal in regard to the provision of expansion joints. In the early work traverse expansion joints were inserted every 25 ft. These joints were generally made with what is known as an "Elastite" joint, extending the whole depth of the concrete, the material consisting of a fibre impregnated with bitumen, forming a slab about ½-in. thick which is placed in position as the concrete is laid, and is usually left slightly high so that the traffic flattens it out to cover the arrises of the joint. Great care is needed to get the concrete face exactly level on each side of the jointing material, otherwise oscillation of vehicles is set up. In early years this bitumen joint was protected by soft steel plates, and where these were kept in exactly the true plane with the concrete they proved satisfactory, but the process of exact adjustment was found so difficult that their use has been abandoned. The tendency is now to lengthen the distance between the traverse joints to 50 ft. or 80 ft. or more, but where reinforcement is used to abandon them altogether, and instead to put in a plank every time concrete laying is stopped, and then either insert a joint material before starting or leave a butt joint only in the concrete.

### Temperature Effects

Having dealt in some detail with the processes of the concrete road, I will proceed to record my observations on the results. Before doing so, I think it best to deal with some of the important physical trials concrete has to undergo in the severe climates experienced in those parts of the Western Continent I have seen, and later with the nature of the traffic carried.

The range of temperatures is very large compared with that experienced in the British Isles, extending from 40 deg. Fahr. below zero to a shade temperature of 100 deg. and probably a sun heat of 140 deg. Great changes of temperature may occur in the course of a very few hours, but cold, when it sets in, is usually prolonged and lasts for several months; while the thaw is usually rapid and must cause extensive disturbance of the subsoil when frost has penetrated, as it does, from 4 ft. to 6 ft. in depth. The effect on subsoil is being very closely studied by both the federal government research department and by the bureau of several of the individual states. I gather that observations have shown that the level of a road surface may vary as much as 4 in., according to the variation in moisture content in the subsoil, and it will be realized that such changes impose a severe strain on a material with so low an elastic limit as concrete.

### Cracks

An indication of these stresses is to be found in the cracks which appear in concrete roads, which can be divided into three classes—transverse, longitudinal, and triangular. Where the elastic joints are frequent, there is not a great deal of transverse cracking, although it is by no means absent; it may not appear for several years, but I think it is fair to say that, as a general rule, the older the pavement the more frequent the transverse cracks.

I could, however, discover no general law governing the process; it might be entirely absent for several hundred yards and then be quite frequent without any observable reason. Longitudinal cracking is similarly erratic, but width of pavement is undoubtedly an important factor, as the narrower pavements were remarkably free. This appears to be accepted as more or less inevitable, as in many of the wider pavements, particularly those over 20 ft., a centre joint is being made, in some cases with an elastic filling, in others a butt joint, sometimes with steel dowels to prevent opening of the joint or lifting of one slab above the other, a phenomenon which occasionally occurs in hot weather following a thaw. I was very interested in the process of crack forming and made a great number of enquiries upon the point. Where the transverse joints are at long intervals it is usual to find some transverse cracks and occasionally longitudinal ones before the road is open to traffic.

The triangular cracks, if present (on most roads they are entirely absent), appear towards the edge of the slab and usually form triangles with the joint as the perpendicular; the hypotenuse may be as much as 6 ft. or as little as 18 in. It is generally attributed to weakness of slab at the sides (it certainly is more evident on the earlier and thinner slabs), or to subsidence of supporting subsoil. Some engineers are now running a ¾-in. steel rod reinforcement 6 in. from the outer edge of the slab, particularly where there is heavy truck traffic.

The roads are always laid in summer months, and in the early summer of the following year it is usual to find further cracks, a process which is repeated the following summer, and then occurs less frequently in succeeding years. The evidence is conclusive, I think, that these cracks are due to subsoil or temperature changes and are not attributable to traffic. It is the practice to go over the roads as soon as settled fine weather is established in the spring, and again in the fall, and fill the cracks with heavy tar or asphalt oil. The cost is said to vary from £5 per mile in the earlier years to perhaps £20 a mile after five or six years.

### Wear of Unsurfaced Concrete

It is the practice to leave the surface of the concrete to take the traffic without any kind of protective covering. In early experiments tar and grit, or sometimes an asphalt oil with similar aggregate, was applied, but it was difficult to obtain regular adherance, and the patchy appearance was objectionable and adverse to smooth running. The surface of the concrete wears extraordinarily even so far as it wears at all. It is a very slow process, as the finishing marks can often be seen on pavements which have been in use for several years. Where there is a great deal of traffic the surface gets darkened by oil droppings, but where traffic is infrequent it gives a light colored surface affording excellent travel for motors, and does not appear to be objectionable to horse traffic, of which, however, there is very little.

I travelled long distances in motor cars at a speed between 40 and 50 miles per hour with only an occasional oscillation caused by an imperfect joint. The cracks (owing to the spreading of the dark filling material outside the actual crack, and forming black and irregular streaks) are unsightly, but do not affect smooth travel, nor do they, if properly attended to, lead to deterioration. Many American engineers accept them as a necessary feature of concrete roads and say, "why worry about them; they are certainly somewhat of an eyesore, but they do not affect the service or stability of the road." Nevertheless, I know they would be very pleased if they could be eliminated, and increased thickness of slab, centre joints, and reinforcement are all adopted in the hope of entirely eliminating or reducing their frequency. Bearing in mind the non-elasticity of concrete I cannot bring myself to believe that the cracking can be entirely eliminated, particularly when one considers the movements of subsoil which necessarily occur from variations in the moisture content at different periods of the year. Travellers on concrete roads become used to the black streaks in time, particularly when they use a road frequently and realise that it does not interfere with comfortable travel, or apparently lead to any serious deterioration.

### Traffic

Now I desire to deal with the important element of traffic. The foregoing observations of course apply to the conditions of traffic which obtain in Canada and the United States, and in judging of the adaptability of concrete roads to English conditions, one has to consider carefully the difference in traffic. America is flooded with motor cars of the light type; in all the large cities, and within a few miles' range, there is a procession of motor cars in both directions, often as far as one can see, on the long stretches of straight and narrowly-paved carriageways, each string keeping to its proper side. It is very difficult on these two-way width roads to pass a slower car, as there is not room to cut in.

The number of these cars on the roads much exceeds anything I have seen in England even on the most-used arteries out of London. On the other hand the heavy type of vehicle is comparatively scarce, and bears a very small proportion to the whole number. One important unit, the motor 'bus, is particularly scarce. In New York and Chicago, on one or two routes, there are a few motor 'buses of a size and weight corresponding to our English 'buses, but they are exceptional instances. The only other passenger vehicles I saw heavier than the taxi were a few country 'buses carrying from eight to ten people, and a very few chars-a-bancs accommodating about the same number, but both these classes of vehicle were invariably running on large pneumatic tires. About the larger towns and their neighborhood there was quite a number of goods delivery vans, and these also had pneumatic tires. "Motor trucks," corresponding to our petrol lorries, exist in considerable numbers, but nothing approaching the proportions existing in England. They appear to me to be generally lighter built than our lorries and some few had pneumatic tires. There are no traction engines except the agricultural engine hauling a threshing machine, and no tractors or steam wagons. Except for the horse-drawn vehicles, which are extraordinarily few, there are no vehicles running on the American roads without rubber tires.

Having regard to differences in traffic conditions I an therefore unable to draw any very definite conclusions from the comparative point of view, as to what the behaviour of concrete roads would be under English conditions, where steel-tired vehicles still form so considerable a proportion of our traffic. I am also unable from what I have seen to judge of the effect of a constant traffic of, say, steel-tired steam wagons, traction engines, or tractors and trailers on a concrete road. It was the threshing season in the states, and I met a few of the agricultural traction engines, but close inspection did not reveal any effects of their passage on the concrete roads. On the other hand, the only evidence of any considerable wear I saw on a concrete road in America was where gravel had been hauled for some years from pits along a route near Milwaukee by rubber-tired lorries, and on the loaded side there was sufficient wear to show a slight track. Moreover, on a few old roads much used by lorries and troops during the war there was evidence of abrasion and deterioration to the extent that some lengths had to be extensively patched, and in a few cases refaced with concrete. The latter process was quite sucessfully carried out by adding a 3-in. reinforced facing, and the patching operations were also quite successful, although such work necessarily had to be protected for at least a fortnight.

### Conclusions

It may be desirable in the light of what I have seen, and my knowledge of English conditions, that I should give my view as to the adaptability of concrete roads to our needs. The general conclusions I have come to are as follows:

1. That well-constructed concrete roads will carry a large traffic of rubber-tired vehicles satisfactorily and at a low maintenance cost for several years, and would then afford a satisfactory base for resurfacing with concrete or for a bituminous surface if originally laid at a level permitting a superimposed coating.

2. That where suitable materials are available at a reasonble cost concrete construction should be adopted for new roads in preference to the telford or macadam system, again provided the carriageway is laid at a level to admit of a superimposed coating.

3. That where heavy traffic is spreading to roads which are insufficiently foundationed to carry it, the concrete method would form a desirable and economical means of reconstruction. Where costs of aggregate is a consideration, the material of the existing road might be excavated, washed and utilized.

I would add that if any good results are to be obtained the concrete must be of first-class quality, with aggregate perfectly clean, thoroughly and regularly mixed, and carefully laid and cured, and traffic kept off for at least three and preferably four weeks. Machine mixers and finishers undoubtedly make the best job and expedite laying, which is important.

With regard to cracks, I am inclined to think they are inevitable in so far as they are the result of temperature changes, and it is probably the best plan to afford an opportunity for them to take place at regular intervals rather than to put in expansion joints, which are difficult to executs so as to avoid light irregularity in the surface line; a crack appears as easy to take care of as a joint. It is probable that cracking would be less prevalent in our own milder climate, particularly having regard to our roads being foundationed, which should lessen materially the effect of subsoil influences.

# Construction Developments During October

## Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded—Analysis of Contemplated Construction

### *Comparative Statement of Contracts Awarded in Canada.*

| According to Geographical Divisions | Ontario | Quebec | Maritime | Western | Total |
|---|---|---|---|---|---|
| October, 1921 | $ 7,888,300 | $ 6,473,800 | $ 542,900 | $ 4,092,200 | $ 18,997,200 |
| October, 1920 | 10,154,800 | 2,674,400 | 2,372,900 | 2,967,400 | 18,169,500 |
| October, 1919 | 7,905,600 | 10,705,500 | 4,300,900 | 2,667,300 | 25,579,300 |
| October, 1918 | 5,207,400 | 1,304,400 | 324,200 | 2,044,100 | 8,880,100 |
| 10 months, 1921 | 93,070,100 | 55,065,500 | 7,600,500 | 48,638,900 | 204,375,000 |
| 10 months, 1920 | 102,231,700 | 47,015,100 | 19,750,500 | 62,462,500 | 231,459,800 |
| 10 months, 1919 | 74,950,800 | 48,361,500 | 16,957,400 | 24,036,400 | 164,176,700 |
| 10 months, 1918 | 30,644,600 | 22,432,700 | 22,248,100 | 16,099,800 | 91,425,500 |

| According to Classifications or Types. | Residential | Business | Industrial | Engineering | Total |
|---|---|---|---|---|---|
| October, 1921 | $ 7,214,900 | $ 5,014,900 | $ 1,616,600 | $ 5,150,800 | $ 18,997,200 |
| October, 1920 | 4,362,500 | 5,279,000 | 6,849,500 | 1,678,500 | 18,169,500 |
| October, 1919 | 4,923,200 | 7,665,900 | 11,319,200 | 1,671,000 | 25,579,300 |
| October, 1918 | 1,161,400 | 2,418,100 | 2,980,300 | 2,320,300 | 8,880,100 |
| 10 months, 1921 | 64,666,200 | 76,432,400 | 14,868,900 | 48,407,500 | 204,375,000 |
| 10 months, 1920 | 50,230,800 | 79,652,200 | 61,871,600 | 39,705,200 | 231,459,800 |
| 10 months, 1919 | 39,796,800 | 51,270,500 | 48,579,100 | 24,530,300 | 164,176,700 |
| 10 months, 1918 | 13,266,500 | 22,723,400 | 36,994,300 | 18,441,300 | 91,425,500 |

**CONTRACTS AWARDED ACCORDING TO CLASSIFICATIONS, JANUARY TO OCTOBER (INCLUSIVE), 1921**

| | Ontario | | Quebec | | Maritime | | Western | |
|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value |
| Residential Buildings | 7933 | $36,821,600 | 2539 | $14,228,500 | 442 | $2,094,000 | 2884 | $11,522,100 |
| Business Buildings | 1099 | 31,452,200 | 627 | 27,094,100 | 151 | 3,212,700 | 949 | 14,673,400 |
| Industrial Buildings | 91 | 5,086,800 | 61 | 3,144,000 | 10 | 290,000 | 42 | 6,348,100 |
| Public Works and Utilities | 419 | 19,709,500 | 241 | 10,598,900 | 69 | 2,003,800 | 267 | 16,095,300 |

## *Construction Contracts Awarded in Eastern Canada, October, 1921*

| | Ontario | | Quebec | | New Brunswick | | Nova Scotia | | Eastern Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value. | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 2 | $ 18,000 | 8 | $ 440,000 | .... | .......... | .... | .......... | 10 | $ 458,000 |
| Churches | .... | .......... | 4 | 175,000 | 1 | $ 8,000 | 2 | $ 80,000 | 7 | 263,000 |
| Factories | 11 | 747,500 | 6 | 793,000 | .... | .......... | .... | .......... | 17 | 1,540,500 |
| Public Garages | 12 | 199,000 | 11 | 173,400 | .... | .......... | 1 | 6,000 | 25 | 383,400 |
| Hospitals | 2 | 132,500 | 3 | 80,000 | .... | .......... | .... | .......... | 5 | 212,500 |
| Hotels and Clubs | 2 | 38,000 | .... | .......... | .... | .......... | 1 | 60,000 | 3 | 98,000 |
| Office Buildings | 8 | 149,000 | 3 | 150,000 | 1 | 10,000 | 1 | 3,000 | 13 | 312,000 |
| Public Buildings | 6 | 148,500 | 2 | 35,000 | 3 | 17,500 | .... | .......... | 11 | 201,000 |
| Residences | 802 | 3,730,800 | 360 | 1,652,700 | 9 | 51,700 | 28 | 108,700 | 1202 | 5,553,400 |
| Schools | 10 | 853,100 | 1 | 6,500 | 2 | 31,000 | 1 | 31,000 | 14 | 921,600 |
| Stores | 55 | 757,700 | 43 | 382,800 | 3 | 19,500 | 6 | 32,900 | 108 | 1,195,900 |
| Theatres | 1 | 40,000 | .... | .......... | .... | .......... | 1 | 18,000 | 2 | 58,000 |
| Warehouses | 7 | 76,500 | 7 | 148,500 | .... | .......... | 1 | 4,500 | 16 | 233,000 |
| Total Buildings | 918 | $6,890,600 | 448 | $4,036,900 | 19 | $ 137,700 | 42 | $ 344,100 | 1433 | $11,430,300 |
| Bridges | 13 | $ 132,100 | 8 | $ 166,500 | .... | .......... | .... | .......... | 21 | $ 298,600 |
| Dams and Wharves | 5 | 55,000 | 3 | 28,000 | .... | .......... | 1 | $ 8,000 | 9 | 91,000 |
| Sewers and Watermains | 9 | 598,700 | 11 | 70,500 | .... | .......... | .... | .......... | 20 | 669,200 |
| Roads and Streets | 15 | 186,900 | 16 | 122,100 | 1 | $ 10,000 | .... | .......... | 32 | 319,000 |
| General Engineering | 1 | 25,000 | 2 | 2,049,800 | 1 | 6,000 | 2 | 16,100 | 6 | 2,096,900 |
| Grand Total | 961 | $7,888,300 | 488 | $6,473,800 | 21 | $ 153,700 | 45 | $ 368,200 | 1521 | $14,905,000 |

## *Construction Contracts Awarded in Western Canada, October, 1921*

| | British Columbia | | Alberta | | Saskatchewan | | Manitoba | | Western Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value. | No. | Value | No. | Value | No. | Value | No. | Value |
| Churches | 1 | $ 3,000 | 3 | $ 24,000 | 2 | $ 14,000 | 4 | $ 22,700 | 10 | $ 63,700 |
| Factories | 2 | 30,000 | 4 | 46,100 | .... | .......... | .... | .......... | 6 | 76,100 |
| Public Garages | 1 | 9,000 | 2 | 30,000 | 2 | 12,500 | 3 | 44,600 | 8 | 96,100 |
| Hospitals | 4 | 152,700 | 2 | 15,000 | .... | .......... | .... | .......... | 6 | 167,700 |
| Hotels and Clubs | .... | .......... | 1 | 100,000 | .... | .......... | .... | .......... | 1 | 100,000 |
| Public Buildings | 2 | 40,500 | 1 | 2,500 | 2 | 15,500 | 3 | 19,500 | 8 | 78,000 |
| Residences | 185 | 703,900 | 38 | 78,300 | 40 | 139,600 | 87 | 281,700 | 350 | 1,203,500 |
| Schools | 7 | 94,900 | 5 | 47,700 | 5 | 25,500 | 2 | 11,000 | 19 | 179,100 |
| Stores | 12 | 98,200 | 10 | 33,200 | 5 | 78,000 | 22 | 129,500 | 49 | 338,900 |
| Theatres | .... | .......... | 1 | 15,000 | 1 | 20,000 | .... | .......... | 2 | 35,000 |
| Warehouses | 4 | 18,000 | 2 | 40,000 | [illegible] | 6,000 | 2 | 14,000 | 10 | 78,000 |
| Total Buildings | 218 | $1,150,200 | 69 | $ 431,800 | 59 | $ 311,100 | 123 | $ 523,000 | 469 | $2,416,100 |
| Bridges | 3 | $ 55,400 | 1 | $ 75,000 | .... | .......... | 4 | $ 20,900 | 8 | $ 151,300 |
| Dams and Wharves | 2 | 21,000 | .... | .......... | .... | .......... | .... | .......... | 2 | 21,000 |
| Sewers and Watermains | 2 | 225,000 | .... | .......... | 2 | $ 3,400 | 4 | 24,000 | 8 | 252,400 |
| Roads and Streets | 2 | 591,000 | .... | .......... | 5 | 80,200 | 3 | 17,000 | 10 | 688,200 |
| General Engineering | 2 | 112,500 | 1 | 372,300 | 4 | 76,500 | 1 | 1,900 | 8 | 563,200 |
| Grand Total | 229 | $2,155,100 | 71 | $ 879,100 | 70 | $ 471,200 | 135 | $ 586,800 | 505 | $4,092,200 |

## *Contemplated New Construction Work in Canada, October, 1921*

| | Ontario | | Quebec | | Maritime | | Western | | Dominion | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value. | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 2 | $ 35,000 | 5 | $ 345,000 | .... | .......... | .... | .......... | 7 | $ 380,000 |
| Churches | 3 | 85,000 | 1 | 30,000 | .... | .......... | 1 | $ 20,000 | 5 | 135,000 |
| Factories | 18 | 483,000 | .... | .......... | 1 | $ 10,000 | 7 | 1,543,000 | 26 | 2,036,000 |
| Public Garages | 6 | 155,000 | 5 | 83,000 | 1 | 6,000 | 4 | 39,000 | 16 | 283,000 |
| Hospitals | 2 | 180,000 | 2 | 260,000 | .... | .......... | 3 | 54,000 | 7 | 494,000 |
| Hotels and Clubs | 6 | 605,000 | 4 | 360,000 | .... | .......... | 1 | 250,000 | 11 | 1,215,000 |
| Office Buildings | 3 | 74,000 | 3 | 235,000 | 1 | 5,000 | 1 | 10,000 | 8 | 324,000 |
| Public Buildings | 6 | 142,000 | 6 | 215,000 | 1 | 25,000 | 4 | 94,000 | 17 | 476,000 |
| Residences | 163 | 849,400 | 212 | 1,467,000 | 4 | 35,000 | 11 | 68,500 | 390 | 2,419,900 |
| Schools | 10 | 1,387,800 | 8 | 454,000 | .... | .......... | 17 | 313,500 | 35 | 2,155,300 |
| Stores | 8 | 110,000 | 5 | 130,000 | 3 | 26,000 | 5 | 86,000 | 21 | 352,000 |
| Theatres | 1 | 40,000 | .... | .......... | .... | .......... | 1 | 20,000 | 2 | 60,000 |
| Warehouses | 2 | 70,000 | 8 | 156,000 | 1 | 10,000 | 4 | 82,500 | 15 | 318,500 |
| Total Buildings | 230 | $4,216,200 | 259 | $3,735,000 | 12 | $ 117,000 | 59 | $2,580,500 | 560 | $10,648,700 |
| Bridges | 8 | $ 94,000 | 5 | $ 96,000 | 1 | $ 60,000 | 2 | $ 8,000 | 16 | $ 258,000 |
| Dams and Wharves | 7 | 237,000 | .... | .......... | .... | .......... | 4 | 27,000 | 11 | 264,000 |
| Sewers and Watermains | 18 | 933,200 | 13 | 291,200 | .... | .......... | 6 | 94,000 | 37 | 1,318,400 |
| Roads and Streets | 12 | 463,000 | 15 | 147,400 | 1 | 17,000 | 10 | 2,150,000 | 38 | 2,777,400 |
| General Engineering | 3 | 3,560,000 | 5 | 121,500 | 3 | 66,000 | 3 | 47,000 | 14 | 3,794,500 |
| Grand Total | 278 | $9,503,400 | 297 | $4,391,100 | 17 | $ 260,000 | 84 | $4,906,500 | 676 | $19,061,000 |

A sketch of the new Wales Home at Richmond, P. Q.

# The Wales Home, Richmond, P. Q.

## Description of a $75,000 Institute for the Housing of the Aged—Semi-fireproof Construction

Situated in one of the most beautiful valleys of the St. Francis River, a mile and a half from Richmond, P. Q. is the site of the Wales Home. This new institution, the purpose of which is to provide a shelter for aged men and women, was made possible through legacies left by the late Horace P. Wales and the generosity of public spirited citizens of the Eastern Townships.

The first building now in course of construction is designed to accommodate forty, mostly in single and four-bed wards. The basement contains a kitchen and laundry, storage and trunk rooms, boiler room, coal, and general service rooms. The ground floor contains men's and women's living rooms, a large dining room, and rooms for such of the inmates as are too feeble to climb stairs. The central portion contains the entrance hall, matron's office, parlor, and cloak rooms. The large living room and dining room are so designed that they can be thrown into one room for the purpose of entertainments, concerts, or any large gatherings. The first floor is devoted entirely to bedrooms and the upper floor to servants' quarters.

Each bedroom is provided with a push button connected with an annunciator in the matron's room for the women inmates. A similar arrangement is made from the men's room to the orderly's room. By this means any one becoming ill at night can secure help at once. Remote parts of the building are provided with automatic telephones to reduce steps of servants and facilitate service. Numerous toilets have been provided conveniently located in different parts of the building; in fact there are only three bedrooms which have not connecting toilets.

A verandah twelve feet wide and ninety feet long provides a sheltered promenade across a portion of the front. The middle portion of this is glass enclosed to form a sun parlor. A deck on the verandah provides lounging and walking space in fair weather and a place for airing bed clothes and linen. The view from this deck is one of exceptional beauty

The construction of the building is sem-fireproof, lack of means prohibiting fireproof construction except in certain parts. For the same reason it was necessary to reduce all decoration to a minimum and avoid any frills which would tend to increase the expense. Laprairie plastic brick was used throughout, laid in Flemish bond on the exterior with raked black joints.

The interior trim of the ground floor is of British Columbia fir. On the first floor the finish is white pine painted with mahogany finished doors. All other parts of building are white pine painted white. The floors throughout are of birch except the toilets which are terrazzo with cove base and Keene's cement wainscots.

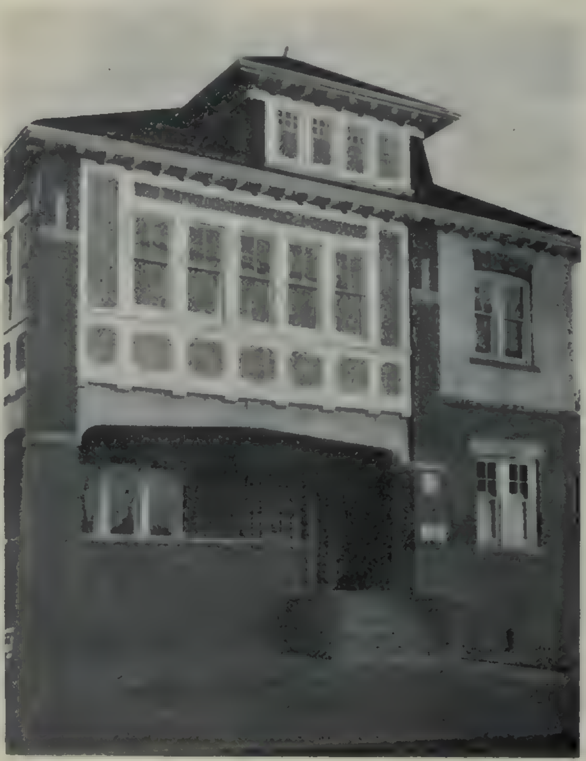
The contract for the building was let early in the spring and cost forty cents a cubic foot not including equipment such as laundry or refrigeration. The architect is Harold Lawson, 127 Stanley St., Montreal and the general contractors are Newton-Dakin Construction Co. Ltd., Sherbrooke, P. Q. The cost will be approximately $75,000.

**Lay in your supply of sand and gravel NOW—the pits will soon be frozen. Store them where they will be sheltered from rain and snow. A ton of aggregates under shelter is worth ten in a frozen pit.**

# A Small House Suggestion

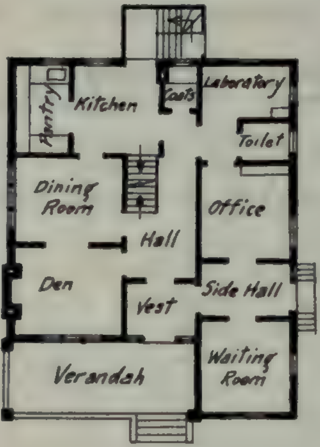
The accompanying illustration and floor plan are of a residence nearing completion on Dawes Road, Toronto, for Dr. Givens. This is an excellent example of a well-planned, permanent, better-class residence and embodies a number of interesting constructional features dealt with briefly herewith.

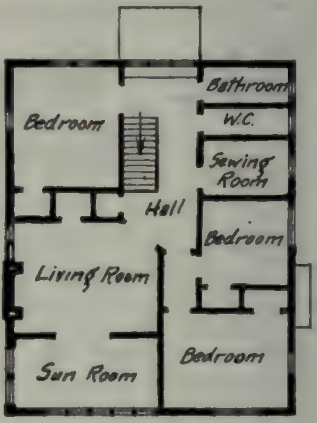
Red pressed brick, stucco, wooden strapping and Indiana limestone trim combine to attractive effect in the front exterior appearance. The other walls are of red pressed brick to the first floor with stucco above. Concrete steps at the front lead up to a roomy verandah, with arched roof and red tile flooring, entering on the vestibule. There is also an entrance on the south side of the house, as shown on ground floor plan, entering on the side hall, for the convenience of patients.



### Description of Ground Floor

The vestibule is floored with red tile, like the verandah, while ⅜ in. quarter-cut oak is used in the halls, den and dining room, and ⅜ in. birch flooring in the waiting room, office and laboratory. The floor in the bathroom and toilet is of hexagon white tiling, and ⅞ in. No. 1 pine is used in the kitchen and pantry. The interior walls are of plaster, throughout, with special sand finish in dining room, den and living room ceilings and walls to plate rail. The bathroom, toilet, kitchen and pantry are trimmed with No. 1 pine, the balance of woodwork throughout being of chestnut. That space utilized, in the case of a residence of this type, for the exercise of professional work, has been laid out with special attention to the convenient location of one room to another. As shown on the plan, the waiting room and office are sitnated immediately off the side hall, the latter room being directly connected with the laboratory at the rear. The large den, 13 ft. by 10 ft., has two entrances, one from the main hall and the other, by large double doors, from the dining room. There is a large fire-place on the north side of the room, of tapestry brick construction and red tile flooring, on either side of which are built-in bookcases. The dining room is the largest room on the ground floor, being 13 ft. by 11 ft. There is a sliding door in the rear wall of the room, connecting with the work table in the pantry, for serving purposes. The dining room is connected with the kitchen by a swinging door, as is the pantry with the kitchen. The kitchen is 10 ft. 6 ins. by 8 ft. 6 ins. and is equipped with a stationary ironing board and an opening to the clothes chute. There is a door at the rear, also, opening on the enclosed stairway to the basement. Access may also be had to this stairway from the outside, as shown on plan.





### The First Floor

The feature of this floor is the large living room, which is 16 ft. 6 ins. by 13 ft., situated immediately over the den, with entrances by double doors on the hall and sun room. A large fire-place, identical with the one in the den, is located in this room. The sun room, over the verandah, is 16 ft. 6 ins. by 8 ft., with five single windows on the front and two on the north side. This room is also connected with a bedroom over the waiting room. There are three bedrooms altogether, the largest 13 ft. 9 ins. by 13 ft.

Mr. Henry J. Chown, architect, of 20 Wayland Ave., Toronto, designed the house, and Messrs. Gilding Bros., 68 Dawes Road, were the builders.

## Steel Company Reduces Wages

The Dominion Iron & Steel Company, Sydney, N. S., has put into effect another ten per cent. reduction in wages. The management stated that this was an alternative to suspending certain operations and that they chose this course in order to keep their staff fully employed.

## Gotfredson Joyce Corporation to Build

A recent report states that the Gotfredson Joyce Corporation, of Walkerville, Ont., will shortly commence construction work on a large garage, service station, offices and showrooms, on Spadina Avenue, Toronto. These different units will be incorporated in a two-storey and basement building, 51 ft. x 210 ft., of structural steel and reinforced concrete construction, to cost about $100,000. Mr. W. H. Leishman, 106 Jarvis St., is the Toronto manager of the corporation.

# Mainly Constructional

**East and West—From Coast to Coast**

The opening of the new Batiscan Bridge, which is the last link in the Montreal-Quebec highway, took place recently. The bridge is 1,219 ft. in length, of steel construction, and cost about $200,000 to construct.

The City Architect's Department, Toronto, reports the total value of building permits issued during the past month of October at $1,825,000, the bulk of which total represents dwelling house construction of various types.

The Toronto Transportation commission has received the assurance of the City Council that $7,000,000, or even more if necessary, will be available for rehabilitation of the street railway system, during the next two or three months.

Premier Drury of Ontario, turned the first sod for the 70-mile extension of the T. & N. O. Railway from Cochrane to Oil Can Portage, Ont. This is the first step in the building of the projected line to Moose Harbor, 185 miles north of Cochrane. Premier Drury used a silver spade to perform the ceremony, which was presented by the municipality of Cochrane.

The new firm of Brant Foundries, at Brantford, Ont., is now under operation and will produce high grade castings, specializing in the production of light grey iron, brass and aluminum castings.

The Anglo-American Motors, Limited, it is reported, have secured a 32-acre site at Trenton, Ont., for the establishment of a plant to consist of ten separate buildings. The site was given by the town free of all encumbrances, with a fixed assessment for a term of years.

Parks Commissioner Chambers of Toronto has recommended to the city council the purchase of a 19-acre site in North Toronto, for playground purposes, at a cost of $8,000 an acre. The site is on the Anderson estate, at the corner of Eglinton Avenue and Duplex Avenue.

The officers of the Canadian Deep Waterways and Power Association were relected en bloc at the recent meeting in Hamilton: President, O. E. Fleming, K. C., Windsor; vice-presidents, E. L. Cousins, Toronto; George J. Guy, Hamilton; George A. Graham, Fort William; T. R. Deacon, Winnipeg; secretary-treasurer, Major Alex. C. Lewis, M. P. P., Toronto. It was resolved to ask the Ontario government for an auunal grant of $15,000 for three years (if required for so long a period).

The city of Kitchener, Ont., has been offered the title to a 25-acre section of land, at St. Leger and Lancaster streets, to be utilized for community playground purposes, by the owner, Mr. A. R. Kaufman.

The ratepayers at Chatham, Ont., are shortly to vote on a by-law authorizing the expenditure of $40,000 on the construction of a municipal incinerator plant.

Water was recently turned on in the new water works system of Scarborough Township, Ont. The entire township is not, as yet being served by this system, but will eventually. This system, which was installed at a cost of $400,000, is the only township owned independent system in the province. The Central Foundation Company were the contractors on the system, which was designed by the township's engineers, Messrs. James, Proctor & Redfern, of Toronto.

Hon. F. C. Biggs, minister of public works, Ontario, accompanied by Mr. W. A. McLean, deputy minister of highways, a committee consisting of 18 members of the legislature, and a staff of engineers, recently took part in the first of a series of motor tours of the provincial highway system of Ontario. The object of these tours is to inspect the work in progress and give the committee an opportunity of seeing for themselves the past, present and future work of the department.

Following is a list of the officers elected at the recent two-day conference of the Provincial Town Planning Association, held at Toronto: President J. P. Hynes, of Toronto, was again returned to office, as were Vice-Presidents Thos. S. Morris, Hamilton; Ald. Frank E. Harley, London; W. H. Breithaupt, of Kitchener; Ald. E. D. Lowe, Ottawa; Treasurer Gordon Philip, London, and Secretary W. S. B. Armstrong, of Toronto. The committee is composed of the following:—J. J. Mackay, Hamilton; Ald. H. E. Rose, St. Catharines; Mayor F. H. Plant, Ottawa; Frank Cockshutt, Brantford; Mrs. Ald. Small, Toronto; Mrs. J. W. Bundy, Toronto; W. H. Morrey, Windsor; George W. McLaughlin, Oshawa, and Major D. Sharpe, Brampton.

Fire losses in Canada during the week ended October 26th are estimated by the Monetary Times at $443,800, compared with $509,750 the previous week.

A harbor commission to represent the Border Cities is projected. According to a recent announcement a bill, which may be presented to the legislature, has been drawn up by the officials of the Border Chamber of Commerce asking for the formation of harbor commission to consist of five members, one for Windsor, one for Walkerville and Ford, one for Sandwich and Ojibway, one appointed by the lieutenant governor of the province, and one by the Border Chamber of Commerce.

## Personal

Brig.-Gen. C. H. Mitchell, Dean of the Faculty of Applied Science, Toronto University, has just returned from the New England States, where he recently addressed the British Empire Club, Providence, R. I., on the "Problems and Prospects of the British Empire."

Mr. George F. Porter, chief engineer of the Canadian Bridge Company, Walkerville, Ont., was recently honored with the honorary degree of Doctor of Laws, by McGill Uuiversity, in recognition of his outstanding engineering work on the Quebec Bridge. Mr. Porter who was born at Detroit in 1862, helped to organize the Canadian Bridge Company in 1900, and since that time has played a prominent part in the important projects which this firm has handled. He is a member of the Engineering Institute of Canada.

# CONSTRUCTIONAL ACTIVITY

## Period of November 2 to November 8, 1921

*Dominion Wide Service Exclusive to "Contract Record & Engineering Review"*

## Waterworks, Sewerage and Roadways

**Amherstburg, Ont.**
W. A. McCormick, Town Clerk, has plans and will receive tenders until Nov. 14th for construction of extension to sewer to cost $15,000.

**Goderich. Ont.**
Ratepayers recently defeated by-law which authorized erection of chlorinating and filtration plant costing $70,000.

**Guelph, Ont.**
H. J. B. Leadley, City Clerk, will receive tenders until Nov. 15th for furnishing, delicvering and erecting 2 motor-driven pumping units, capacity 2,100 imperial gallons per minute each, and 2 pumping units driven by internal combustion engines, capacity 2,100 imperial gallons per minute each. Plans with F. McArthur, Engr.

**Ottawa, Ont.**
City Council plan construction of asphalt pavement on Bayview Ave., from Armstrong to Wellington Sts.

Construction of asphalt pavement on Armstrong St., from Garland to Bayview, is contemplated by City Council.

**Saanich, B.C.**
Hector Cowper, Clerk, has plans and will receive tenders by registered post only at Municipal Hall, Royal Oak, Saanich, B.C., until Nov. 17th for supply of materials required for waterworks. Bid must be accompanied by certified cheque for 5 per cent. of tender.

**St. Joseph de Coleraine, Que.**
B. Michaud, Deputy Min. Dept. Pub. Highways, Prov. Govt., will receive tenders until Nov. 19th for gravelling section of Sherbrooke Highway.

**St. Thomas, Ont.**
Plans will be prepared for construction of asphaltic concrete pavement on Mary, Mitchell and Hiawatha Sts. for City. W. C. Miller, Engr.

### CONTRACTS AWARDED

**Dauphin, Man.**
Rural Municipality of Dauphin, Man., awarded following contracts for roadwork: 1 and 2 at $13,200, Strang & Watson, Dauphin; 3 at $7,500, E. Pilgrim, Dauphin.

**Kingston, Ont.**
R. J. McClelland, 185 Clergy St., Kingston, has general contract for grading and paving at Riding School, Military College, for Dom. Govt., Dept. Pub. Works.

**St. Lambert, Que.**
Council awarded contract for concrete pipe to the Concrete Pipe & Products Co., Ltd., Junction Cut, Hamilton, Ont.

## Railroads, Bridges and Wharves

**Toronto, Ont.**
Toronto Transportation Cmsn., Ryrie Bldg., contemplate erection of addition to car barns on Connaught Ave.

Erection of addition to car barns on Eglinton Ave. is contemplated by Toronto Transportation Cmsn., Ryrie Bldg.

### CONTRACTS AWARDED

**Bromptonville, Que.**
Steel contract for bridge costing $8,500 for Brompton Twp. Council is placed with MacKinnon Steel Co., Ltd., Drummond Rd., Sherbrooke, Que.

**Providence Bay, Ont.**
General contract for repairs to wharf for Dom. Govt., Dept. Pub. Works, is awarded to McNamara Bros. & Thornton, Cullis Block, Sault Ste. Marie, Ont.

## Public Buildings, Churches and Schools

**Benmiller, Ont.**
J. W. Gledhill, secy. Benmiller Consolidated School Bd., has plans and will receive tenders until Dec. 15th for erection of school costing $15,000.

**Cabano, Que.**
Erection of church is contemplated by Congregation of Cabano. Rev. J. P. Cyr, Parish Priest.

**Colebrook, B.C.**
Jos. T. Brown, Colebrook, Surrey, B.C., is erecting Community Hall at cost of $7,000.

**Kitchener, Ont.**
Erection of addition to school costing $50,000 is contemplated by School Bd. Ed. Pequegnat, secy., 53 Frederick St.

**Levis, Que.**
Erection of sanatorium at cost of $100,000 is contemplated by Hotel Dieu de Levis, 19 St. Joseph St.

**Tillsonburg, Ont.**
Plans will be prepared for remodelment of residence for hospital for Town.

**Waterdown, Ont.**
J. C. Meblar, Clerk, Waterdown, and Witton & Walsh, architects, Hamilton Provident & Loan Bldg., Hamilton, have plans and will receive tenders until Nov. 12th for erection of Memorial Hall to cost $20,000 for Town.

### CONTRACTS AWARDED

**Amherst, N.S.**
General contract for work at Drill Hall for Dom. Govt., Dept. Pub. Works, is awarded to N. & M. Daskallino, 10 Compton Ave.

**Brooklands, Man.**
John Mason has general contract for erection of school costing $6,500 for Brooklands S.D. No. 1440.

**Glace Bay, N.S.**
A. M. Jones, Glace Bay, has general contract for erection of Central School costing $400,000 for School Bd. Millwork and electrical contracts are awarded to Rhodes, Curry Co., Amherst, N.S., and J. A. Donovan, Margaret, St., Sydney, N.S.

**Hamilton, Ont.**
Roofing contract for school costing $300,000 for Bd. of Education is awarded to Thos. Irwin & Son, 18 McNab St. S.

**Marieville, Que.**
Additional contracts for hospital for Les Soeurs de la Charite de L'Hospice, St. Croix de Marieville, are: Electrical, J. A. St. Amour, 2171 St. Denis St.; plumbing, Mr. Bernier, St. Hyacinthe; heating, T. Latourelle & Fils, 6 Craig St. W.; painting, Birch & Drouin, 195 St. Catherine St. E.; steel arch, Phoenix Bridge & Iron Iron Works, Ltd., 83 Colborne St., Montreal; sash and doors, Allard & Desnoyers, 12 Erie St., Montreal.

**Montreal, Que.**
Additional contracts for addition to hospital costing $225,000 for Ste. Justine Hospital for Children, St. Denis St., are: Roofing, Paquette & Fortin, 79 Cathedral St.; painting and glass, Bruno Navert, 1229 St. Denis St.; plumbing and heating, J. A. Francoeur, 538 Fabre St.

Elex. Craig, Ltd., 41 Jurors St., have painting and glazing contracts for school costing $500,000 for Protestant Bd. of School Cmmrs., 36 Belmont St.

Marble, tile and terrazzo contracts for chapel for Parish de la Nativite, 306 Desery St., are awarded to Emile Lepage, 990 Parthenais St.

**St. Chrysostome, Que.**
H. Pepin, 54 McGuire St., Montreal, has roofing contract for rebuilding church at cost of $120,000 for Parish. Contracts for plumbing and heating, and millwork and interior trim are awarded to Conroy Bros., 29. Centre St., Montreal, and A. Lafleur, Valleyfield, Que.

**Toronto, Ont.**
Additional contracts for school costing $150,000 for S.S. No. 26, York Twp., are: Roofing, Carmichael Water Proofing Co., 918 Palmerston Ave., Toronto; electrical, Harris & Marson, 81A Parkway Ave., Toronto; painting and glazing, J. Moore, Lumsden Ave., Toronto.

Roofing contract for school for S.S. No. 7, York Twp., is awarded to Carmichael Water Proofing Co., 918 Palmerston Ave., Toronto.

General contract for erection of church costing $75,000 for Church of Resurrection is awarded to Sullivan & Fried, 81 Victoria St.

**Victoria, B.C.**
Contracts for addition to hospital costing $107,986 for Royal Jubilee Hospital, are: Reinforcing steel and cement, Evans, Coleman & Evans, Ltd., 613 Pandora Ave.; structural steel, J. J. Coughlan & Sons, Vancouver; brick, Clayburn Brick Co., Vancouver.

## Business Buildings and Industrial Plants

**Berwyn, Alta.**
Gillespie Elevator Co., Edmonton, Alta.,

ESTABLISHED 1886
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and Engineering Review

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## *Store Road Building Materials on the Job During the Winter Months*

The time is again opportune for reminding road contractors that the approaching winter will offer a splendid opportunity for the accumulation of such material and equipment as will enable them to proceed with actual construction early in the spring. This year, in Ontario alone, a record mileage of highway construction was completed, largely because the highway department undertook to award contracts early in the season, thereby being assured of an early commencement of the work. Even better results may be expected next year, as the department, we understand, is calling for tenders on many contracts at an earlier date than it did last season. This will give contractors many weeks in which to plan their organizations and arrange for their supplies, mechanical equipment and labor. If they are wise, they will see the advantage of transporting and storing at the point of consumption during the winter and early spring months the stone or other materials that may be necessary for road building operations. During that time of the year congestion on the railways is practically eliminated and there is available a plentiful supply of open-ton cars for the haulage of road materials. Should contractors be fortunate enough to get their stone from quarries near the site of their contracts, the hardness of the roads during the winter months will enable trucks, wagons or sleighs to haul much more effectively than when the spring thaw has softened and broken up the roads.

Aside from enabling the contractor to make an early start on his work, the accumulation of supplies during the winter and early spring months will be productive of many economies throughout the entire season, by assuring a constant supply of materials without the possibility of shutting down the road plant at frequent intervals for want of supplies. Of course, the interest on the money represented by stored materials tends to increase the cost, but it has been found by many contractors who have followed the procedure advocated herewith that the economies of steady production more than offset this interest item. In some cases it may be possible for the contractor to be given a credit from the municipal, county or provincial highway organizations on account of materials delivered. In any case, he will be well advised to take into serious consideration the possibility of hauling his road materials to the site of his contract during this coming winter and early spring months.

## *Awarding of Highway Contracts in The Fall*

This journal has frequently advocated the awarding of road building contracts in the fall, or at least early enough to enable contractors to start work immediately upon the break-up of winter. The advantages of this procedure are almost self-evident and already many highway departments are adopting the practice. In the province of New Brunswick early letting is apparently advocated, as the following letter from Mr. B. M. Hill, provincial road engineer, is entirely favorable to the awarding of contracts in the fall:

With conditions at normal, I am strongly in favor of awarding contracts the fall previous to the construction period. Whilep rices were rising or when prices were falling this method of awarding contracts was inadvisable for the following reasons: (1) On rising prices contractors protected themselves by putting on higher prices than the usual amount of the rise between the fall and spring. (2) With falling prices contractors did not lower their prices usually the full amount of the drop which would occur in the price of material and wages. I now believe that we are so nearly back to normal that fluctuations in prices of materials and wages will be very small.

I am very strongly in favor of awarding contracts in the fall preceding the construction period, as I believe that greater efficiency is obtained and much lower prices are bid by contractors for a number of reasons, the chief of which is as follows: Greater competition among contractors, because as old contracts are about to be completed the contractors are anxious to obtain new work to provide for the use of their road building equipment the following season. If new equipment is required it can be purchased better during the winter months, as the contractor has an opportunity to investigate road building equipment and purchase exactly what he needs, wheras if he waits until the spring he has to rush all his equipment on to the work so as to get started, with the result that many times he purchased unsuitable equipment in his efforts to get the work started so that he may finish on time. The contractors are also able to better organize their work and to building up an organization of sunperintendents and foremen. They are also able to use their permanent staff of office and field men to advantage during the winter months, in the purchase and assembling of equipment and material. If the work is located at

*No. 69*

## *Canada's Engineers—F. T. Cole*

**One of the younger members of the engineering profession who has already obtained prominence in his chosen field has been selected to appear on our series this week. He is Mr. F. T. Cole, in charge of the engineering work of the Eastern Canada Steel & Iron Works, Quebec, P.Q., a firm that has carried out a great deal of the important structural steel building in the province of Quebec and Eastrn Canada in general. Mr. Cole is a graduate of McGill University, having been a member of the class of 1910 in civil engineering. After leaving College, he entered the employ of the Dominion Bridge Company, where he received a splendid grounding in the structural engineering field, well calculated to lead to his success in his present capacity.. With that company he was successively employed in the draughting, designing and sales departments, both in Montreal and Toronto. In the latter city he was for a time resident engineer. In 1913 he came to Quebec to take charge of the engineering work of the Eastern Canada Steel & Iron Works. Among the many contracts which this firm has carried out in recent years are included: St. Anne's College, Dufferin Terrace, Quebec; Exhibition grandstand, Quebec; Quebec harbor freight sheds and unloading grain galleries; Louisville church; Chicoutimi cathedral; the Metabatchewan Bridge; large foundry building at Montmagny, P.Q.; large sawmill at Braeside, Ont. Among the more recent jobs handled by the Eastern Canada Steel & Iron Works are the addition to Laval University and the remodelling of a four-storey bank building, to accommodate four storeys above.**

**Mr. Cole is a member of the Engineering Institute of Canada and of the Corporation of Professional Engineers of Quebec. He is also a member of the sub-committee on bridges of the Canadian Engineering Standards Association.**

Mr. F. T. Cole

some distance from the railway station, material and equipment can be delivered during the winter months on the snow much better than in the spring of the year, when by-roads and cross roads are not in condition for heavy traffic until very late in the season. This would apply to practically all of our provinces.

By awarding contracts in the fall of the year, we practically lengthen the construction season by 50 per cent., work can generally start the 1st of May and continue until the 1st of November, whereas if the contract is let in the spring, work usually gets started about the 1st of July and ends the 1st of November, giving only four months construction season against six months.

Another point which is strongly in favor of getting the work started early in the spring is to prevent the work being carried on late in the fall during the fall rains and cold weather. The result of awarding contracts in the fall is that the work is generally completed and trimmed up in perfect shape so as not to be injured by fall rains and snowstorms, whereas work let in the spring is not usually completed until very late in the fall, when it is impossible to trim the work up and leave it in proper shape to withstand the frost and rains. This results in the contractor having to do a lot of trimming and repairing the year following the construction work, and he naturally adds to his price to cover this expenditure. There is not the slightest doubt in my mind but that lower prices can be obtained by awarding contracts in the autumn preceding the construction period.

### CANADIAN WELDING SOCIETY'S PROGRAM

The regular monthly meetings of the Canadian Welding Society, Montreal Section, will be held, commencing in December, on the second Monday of each month. The December meeting will be held at No. 617, Montreal Power Building. Mr. A. M. Barrie will submit a paper, illustrated by moving pictures and lantern slides, explaining the three welding processes as applied to commercial uses.

The society has appointed a committee, consisting of Messrs. Reynolds, Burton and Girouard, for the purpose of arranging for the presentation of a series of papers of interest to the welding and allied industries during the coming winter.

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### U. S. FIRM SECURES RIGHTS TO MANUFACTURE CAST IRON PIPE BY DE LAVAUD PROCESS

The announcement is made that negotiations have been completed between Gordon F. Perry of Toronto and the United States Cast Iron Pipe & Foundry Company of Philadelphia, whereby that company obtains the exclusive license in the United States for the manufacture of cast iron pipe by the de Lavaud process. The National Iron Corporation, Toronto, of which Mr. Perry is president and general manager, are meeting with great success in the manufacture and sale of pipe made under this process. The Stanton Iron Works Company of Nottingham, England, who control the rights for Great Britain and Continental Europe, have recently opened their new plant to supply these markets.

# Road Work on Dundas Highway

## Macadam Foundation Being Placed on the Western Portion of the New Provincial Route from Toronto to Hamilton—Heavy Rock Cut Supplies Stone for the Job

One of the most important units in the Ontario provincial highway system is the Dundas Road from Toronto to Hamilton, which, when rebuilt, will very materially relieve the congestion on the present Toronto-Hamilton highway, which follows the Lake Ontario short route. The Dundas Road is more inland than the present highway and more direct. Work was started on its improvement this spring, but it is not anticipated that it will be entirely paved until the fall of 1922. Prior to its improvement, Dundas Street, excepting for metalled sections in the vicinity of Toronto and Hamilton, was for the most part a heavy clay, almost impassible in wet weather. Grades in many cases were steep and at the Sixteen-mile and Twelve-mile Creeks there were two deep ravines which the road traversed at grades as steep as 16 per cent. Both of these valleys are now crossed by long bridges, one of which is just being finished under the direction of the Ontario Department of Highways and the other of which was constructed by the county prior to the taking over of the road as a part of the provincial system.

Steam shovel in rock cut loading stone on dump cars to be crushed for foundation macadam

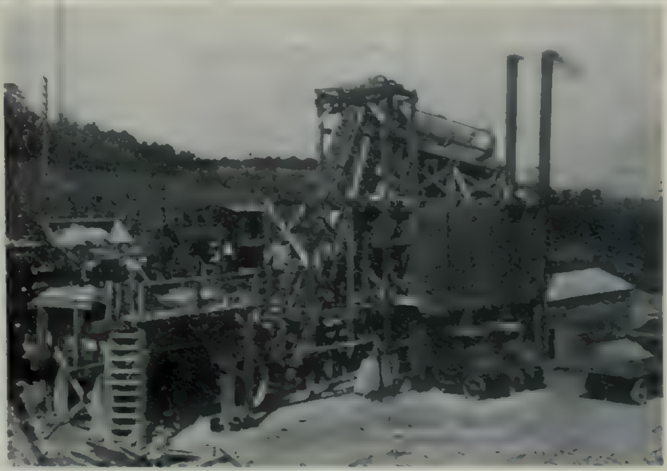
The portion of the road which is the subject of the description herewith, runs from Clappison's Corners, near the Hamilton terminus of Dundas Street, east to the Twelve-mile Creek bridge, a total distance of about 12 miles. On this section, the Dufferin Construction Co., Ltd., of Toronto, have been operating during the past season, laying a macadam base, which next year, according to the Highway Department, will be surfaced with asphaltic concrete. A considerable portion of the section in question had already been paved with macadam, so that the road is well consolidated and affords a firm foundation for the new macadam. The new road is 20 ft. in width and two 5 ft. shoulders.

The outstanding feature of this contract is a heavy rock cut, about midway between Clappison's Corners and the Twelve-mile Creek. At this point a limestone cut, 40 ft. deep by 30 ft. in width is necessitated to carry the road at a reasonable grade. The old road was carried over this outcropping on a rather steep grade that deviated from the main location of the road allowance. The heavy rock cut is consequently being undertaken to make the road conform to the Highway Department standards for grading and alignment.

This cut has been made efficient use of as a source of supply for the rock necessary for macadamizing the straightaway portions. In order to produce the stone, a complete rock crushing and screening outfit has been erected on the site of the cut. This site had originally been the location of a county stone pit, but the plant which had been in use there was dismantled to give way to equipment of a larger capacity installed by the contractor.

The rock in this cut is blasted out and handled by a steam shovel into dump cars which carry it to the crusher. The drilling equipment consists of one small steam drill, two jackhammers operated by air and two gasoline well drills. A small boiler on the top of the hill supplies steam for the steam drill, while the jackhammers are fed by air from a locomotive compressor in the boiler house of the crusher plant. A three-quarter yard Erie steam shovel operating in the pit loads the rock into 4-yd. side dump cars hauled by a steam dinkey. The track is carried onto a ramp over the crusher, so that the cars may dump the rock directly into the jaws. In the pit the track is Y'd so that there may always be cars being loaded while others are being dumped.

The entire crushing plant was designed and installed by the Dominion Road Machinery Co., Limited, of Goderich, Ontario, and consists of one 22 in. x 50 in. Champion jaw crusher, 50 ft. elevator with buckets 24 in. in width, 51 in. diameter screen, 24 ft. long, operated by a 100 h.p. engine and two 60 h.p. Waterous boilers.



Large crusher plant handling rock from heavy cut.

The capacity of the plant is from 900 to to 1,000 tons of crushed stone in a ten-hour day, or from 90 to 100 tons per hour.

The actual weight of the crusher itself is about 65,000 lbs., or well over thirty tons, and one's first thought how such a heavy piece of machinery can be handled to advantage in the work of road-making, but the fact is that this crusher differs somewhat from other types, the frame being built up of specially rolled steel plates, instead of a huge, heavy casting, as in other machines of this size. As a matter of fact, the heaviest part of this machine only weighs 7,000 lbs., or 3½ tons, and is, therefore, exceptionally well designed for this class of work. The crusher can be shipped in trucks over almost any kind of road and assembled on the job. In this case, the assembling was greatly facilitated by the use of the steam shovel, which was used as a derrick for lifting the heavy parts into position.

Two features of this crusher are worthy of note: (1) The moving jaw is in two parts, operating side by side, but alternating in the closing or breaking movement. This overcomes to a very large extent the tendency of large, round boulders to jump out of the grip of the jaws; (2) the jaws, in place of being worked by a single cam movement of the driving shaft, are operated by a double cam or egg-shaped shaft, the advantage being that there are two grips or breaking movements of the jaws, at each revolution of the shaft. Therefore, the speed of the drive can be cut in half, thereby reducing the wear on the bearings, etc., which result in a great saving in repairs to the wearing parts. This machine is run at about 105 r.p.m., whereas any other make of jaw crusher would require a speed of 210 r.p.m., to produce the same amount of work. In heavy duty machinery of this type, the advantages of this item can be easily appreciated.

The elevator frame is built in three lengths. The screen is collapsible and the boilers are mounted on wheels, making the entire plant what might be called "semi-portable," easily dissembled or assembled in a very short space of time.

The jaws of the crusher are set to give 4 in. stone, which, with the screenings, is the only size used on the road work. The screens, however, also separate 2 in. and 1 in. stone, which is dumped by the contractors on stock piles for future use in the surfacing operations.

Stoning on the Dundas Road in progress.

### Macadamizing Operations

Macadamizing operations are being carried out to the east of the quarry, starting at a point about three miles east and working toward the centre of supply. Seven 5-ton trucks with end dump elevating bodies, carry the stone from the pits at the crusher to the side of the work. It is there deposited to a depth of 5 in. before consolidation, which, after rolling, becomes 4 in. The 4 in. stone is thoroughly compacted and interstices filled with screenings, which are sprinkled and thoroughly rolled in. Water for the steam rollers and for sprinkling is obtained at one part from a spring and at another point from Twelve-mile Creek, the former being a gravity supply and the latter pumped. Sprinkling is facilitated by a truck with a water tank and sprinkler outlet. East of this macadamized section, the road has been graded, although no metal has been applied. When the contractors are ready to proceed with this, they will have to haul over the newly laid macadam, but as this is intended only for foundation, no serious harm will result through the passage of heavy trucks over the stone.

A view of the crusher which has a capacity of 900 to 1,000 tons a day.

On the section of the contract from the quarry west to Clappison's Corners, grading for the most part is all that has been carried out. A short section in the village of Waterdown has been macadamized, the stone for this portion being purchased from another quarry.

The grading on this section follows the procedure that was adopted on other portions of the contract, a steam shovel grading the surface and excavating the ditches. Teams and trucks convey the soil to portions of the road where fill is necessary. The steam shovel has been found capable of attending to practically all the grading and ditching work, and the contractors have rarely had to fall back on hand labor.

Rapid progress is being made, macadamizing progressing at a rate of 800 ft. a day and grading at a rate of 1,800 ft. a day. Unless the weather proves unduly severe, work will continue throughout the winter. The efficiency of the job has been kept up by the establishment of a camp at the site, which comprises two bunk houses, cook house, garage, repair shop, blacksmith shop and the storeroom, the buildings being lighted by self-contained gas and electric outfit. About 65 men are involved at the present time.

The work is under general supervision of Mr. J. Franceschini, president of the Dufferin Construction Company. His engineer on the work is Mr. E. Irvine, while the interests of the provincial highway department are being attended to by R. M. Smith, district engineer, and G. C. Greig, resident engineer.

# First Fireproof Sawmill in Canada

## New Plant of Gillies Bros., Ltd., at Braeside, Ont., is of Steel and Concrete Throughout, with the Fire Hazard Reduced to an Absolute Minimum—Machinery Electrically Driven

Unique in construction, daring in achievement and imposing in appearance, is the new fireproof, electrically-driven, steel and concrete sawmill of Gillies Bros., Limited at Braeside, Ont. The structure is the only one of its kind in the Dominion and marks a new era in sawmill enterprises. To carry out a project of this proportion, expenditure and design required vision, faith and courage, for the plant of Gillies Bros., Limited, is one that establishes a radical departure from the usual run of activities in the lumber line. The capacity of the mill is 150,000 feet a day.

The site selected for the new mill is about a mile east of the former mill of the company, which was burned on June 22nd, 1919. Ground was broken for the structure on October 15th of the same year, and work was continued that fall and throughout the greater portion of 1920. The mill was given a trial run in October, just a year after consruction started. Pending its erection and completion, the logs of Gillies Bros. were sawn by the Hawkesbury Lumber Co. at Hawkesbury, so that there was practically no interruption in the usual output of the firm.

Although the new mill was given a partial trial run last autumn, it was not until April 25th of this year that it was put fully into commission. After "finding itself" all the equipment has run smoothly and the maximum output was reached within a comparatively limited period.

The location on Chats Lake is an admirable one. The mill rests on a solid rock foundation and is, as already stated, built entirely of steel, concrete and brick, with practically no wood in the whole edifice. It is as nearly fireproof as any modern warehouse or metropolitan hotel. The members of the company desired and determined to build for the future, to avoid the repetition of a fire, to minimize repair bills, the replacement of timbers and other portions, such as a frame sawmill entails. In addition, they wished to turn out evenly sawn and accurately gauged lumber.

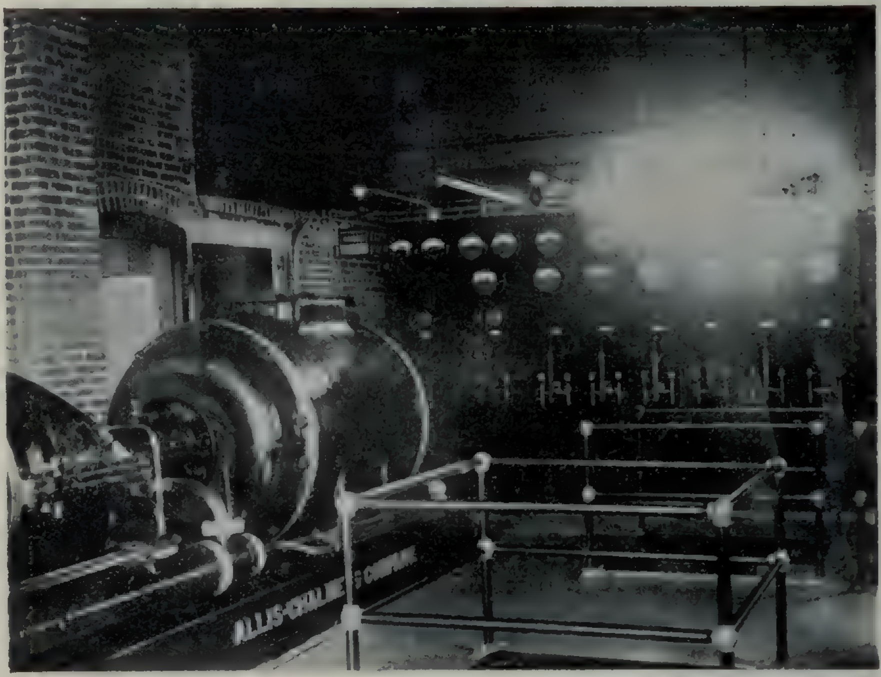
The whole structure, its layout, specifications, equipment, operation and production, were thought out and designed after consulting with leading engineers, structural designers and electric contractors. Nothing was hurriedly undertaken, due consideration being given to all the important points and problems arising from such a venture. Not only was the idea of permanency involved, but in the economic sawing, sorting and handling of all the lumber and other products from the log, an exhaustive investigation was conducted before a final decision was reached.

### Character and Layout of the Plant

The mill proper, which is 75 x 190 feet in dimensions, is fitted throughout with the equipment of Clark Bros., Olean, N.Y., suppliers and builders of sawmill machinery. This firm prepared the machinery and general plans under the supervision of and in collaboration with the members of Gillies Bros.' staff. The consulting engineers in regard to the building itself and the electric equipment were J. M. Robertson, Limited, Montreal, and during construction the resident engineer was Major W. H. Wardwell, Montreal, who represented J. M. Robertson, Limited, and was responsible for all the detailed plans of the structure. All the information supplied by Clark Bros. had to be co-related and co-ordinated owing to the building itself being entirely of steel, concrete and brick, and this task was one of no small magnitude or importance.

The general contractors of the building were A. F. Byers & Co., Limited, Montreal, who carried out their

A part of the sorting shed of Gillies Bros. mill—the first fireproof sawmill in the country



Interior view of the engine room in Gillies Bros.' new fireproof sawmill. Electric drive is used throughout, there being 48 motors in the building.

work expeditiously under the direction of Mr. W. C. Hyde, engineer in charge. The Canadian Westinghouse Co., Limited, of Hamilton, furnished the electric motors throughout the plant.

The mill itself is a reinforced concrete building of structural steel frame, with steel trussed roof, which is covered with heavy, galvanized, 26-gauge iron. The basement is nineteen feet in height. The supporting columns are of reinforced concrete and the weight of the building is carried by these columns and connecting concrete beams, the structure being enclosed by 8-inch brick curtain walls between the outside row of columns. In the construction of the sawing floor alone 70 tons of steel reinforcing bars were used. In the design and construction of the plant every bolt-hole, bearing, hanger, pulley, shaft, driving power, weight of machinery, etc., had to be carefully considered, planned and perfected and incorporated in the building plans months before the machinery and equipment were actually on the ground.

### Forty-eight Motors Drive the Machinery

Leaving for a moment the structural part of the mill, it is well to take a look at the power department, which is housed in a separate brick and concrete building, 50 x 80 x feet. In the boiler room are five 72-inch diameter tubular boilers, each 16 feet in length, two of them being Polson and the remainder Scannel. The boilers are equipped with Dutch ovens, which are fed by gravity from an overhead conveyor which delivers all the sawdust and hog chips from the mill. There are additional outlets in the sawdust conveyors in order that surplus fuel may be deposited on the concrete floor to keep the fires in the boilers going during the night and for fire protection on Sunday.

The steel smokestack of the mill is worthy of special mention. It is entirely without guys and is self-supporting, being 150 feet high and resting on a 10-foot concrete base. The diameter of the stack is 6 feet 6 inches.

In the engine room, which adjoins the boiler room, the main power unit is an Allis-Chalmers condensing turbo-generator of 500 k.v.a. There is an auxiliary equipment of exciter engines, vacuum pumps, etc. There are three steam fire and boiler feed pumps, while in the mill are located 22 hydrants or stand-pipes, each connected with 2½-inch standard gauge hose. An 8-inch steam pipe supplies the steam feeds, also the steam loaders, kickers, niggers and set works of the carriages in the mill, as well as the nine steam trips located on the various lines of live rolls.

The mill equipment, as already pointed out, is driven entirely by electricity, there being 48 motors, single and in groups, scattered throughout the various departments, ranging from 1 up to 150 h.p. Gillies Bros. produce all their own electric energy, but in the event of the mill being shut down for repairs or operations being carried on at night, there is an auxiliary connection with the system of the Galetta Electric Power & Milling Co., from which power can be obtained for the machine shop, filing room, etc.

Each of the three band saws is operated by 150 h.p. slip-ring motor and the band resaw by 100 h.p. motor. The band mills are equipped with 8-foot wheels and 12-inch double cutting saws. The three carriages are run by 12-inch gunshot, steam fed cylinders. One carriage possesses a trailer, which enables the mill to cut timbers up to 28 feet in length. The large log carriage is steam set, the two other carriages being hand-set and each is operated by three men—one setter and two doggers. All exhausts from the steam feeds, niggers, kickers and loaders are collected in a header and exhaust in one 10-inch pipe carriage above the roof.

### How the Original Plans Were Prepared

The jack ladder of the mill is wood up to the first bent from the water and for the remainder of the distance it is reinforced concrete. Practically the only wood used in the mill is some hardwood flooring in the filing room and on the lumber transfer at end of live rolls. This flooring is, however, laid over 4-inch reinforced concrete and is practically unburnable. It may be stated in passing that there is only about 5,000 feet B.M. of wood in the entire mill.

At the top of the jack ladder the logs are measured as they come up and the jacker operates steam kickers which throw the logs on the different decks for the band saws. At the immediate left there is a chain transfer which carries the medium-sized logs to one band mill. To the shorter deck on the same side of the log chain, but farther back, are forwarded all the small logs to supply the centre band mill where some of the very small ones are split in the middle and sent on live rolls and transfers back to the 7-foot horizontal band resaw which also takes care of all slabs. The band mill on the right cuts up the larger logs.

There are three Clark Bros. edgers in the plant, two being single, with three saws, and the third a double 2-man edger, with 6 saws. The motors driving these are direct connected, the rotors being keyed to the arbors.

A slasher transfer crosses the floor directly behind the edgers and picks up all the edgings and refuse slabs from the whole mill. Farther on is the transfer, which delivers the good slabs to the band resaw. All slabs that will produce pieces ⅝-inch thick and 6 feet long are despatched to the resaw and converted into crating, boxing and other materials. All the automatic trips of the edgers, slasher and resaw transfers are operated by steam, the ones to the edgers being controlled by the tail sawyers, the others by trip men stationed on a centrally located platform.

The material carried to the five-saw overhung slasher falls into a steel trough conveyor and goes to the box and picket department, which is in a separate building 35 feet x 100 feet in dimensions. All suitable stuff is first put through a Moreen-Johnson horizontal band resaw equipped with 60-inch wheel and using an 8-inch blade. The box boards from the 4-foot slabs, which are edged and trimmed on the very latest machines, fall through chutes to the floor below, where they are sorted and loaded on rollers for shipment to the yard. All material, 4 inches and wider by 16 inches and longer, and from ⅝-inch to 2 inches thick is converted into box boards. In this department the box board edger, box board trimmer, picket and wood machines, etc., were supplied by the William Hamilton Co.

### Utilizing All Waste to Advantage

The remaining edgings and slabs suitable for pickets, from 16 to 48 inches long and 1 to 1½ inches thick, are picked out and run through the picket machines. The pickets then drop into a steel hopper to the floor below, where they are sorted as to length and bundled. The pieces not suitable for pickets are taken from the trough conveyor and put through a lath bolter and lath machine. The lath are then sorted, tied and trimmed, and lowered to the ground floor, where they are loaded on lorries. All 2-inch blocks, suitable for matches, are next picked out and small edgings are dumped into the "hog" to provide for the boilers. 4-foot and 16-inch wood is also collected in hoppers to be used in the village or shipped away for fuel.

After all these processes, the residue—which, by the way, contains nothing of value or practical use so thorough is the system of elimination—is conveyed by steel carrier to the burner. This huge receptacle is 28 feet in diameter, 100 feet tall and brick-lined up to a height of 80 feet, and was, with the boilers, the only equipment salvaged from the old mill after the big fire.

The sorting and trimming shed, which is 236 feet long and 50 feet wide, has a steel trussed roof and is built on six concrete walls supporting reinforced concrete slabs forming the sorting-table and supports for the sorting rolls. After the lumber from the mill drops on to the transfer table, or sorting table, there is a return transfer table running parallel to the sorting chains, but in the reverse direction, on which any boards, not properly edged or butted, are sent back by the culler into the mill to be remanufactured as required. The sorting rollers are cast iron, bearings for the same being on 5-inch steel channels on edge, bolted to the concrete slab, and these rollers are 16 inches below the level of the runway, on which the sorters stand. This eliminates heavy lifting, a five-foot bunch being very little higher than the transfer chains. The boards are placed in two separate piles or bunches on turn table lorries and hauled out to the yard by an oil-burning locomotive. The bunches of lumber are next cranked off the roller top lorries on to the piling frames built between the lumber piles. The yards contain some eight miles of standard gauge railway track, all standard 60-pound steel, and there is an ample area for piling 40 to 50 million feet of lumber.

### Some Outstanding Features Reviewed

There are several features about the Gillies mill operation that are worthy of mention. One is that from the river to the pile one team of horses only is employed to handle all the lumber produced by the mill, being used to place lorries for loading, and when loaded, couples them up in a small train ready for the locomotive. Not one horse cart is used about the plant—all sawdust, bark and refuse being handled by the complete system of fourteen conveyors. Another feature is that the band saws are elevated to and lowered from the filing department by means of a special frame operated by a small hand winch.

The equipment in the filing room includes the latest machines for this class of work, the grinders, stretchers and brazing outfits being electrically driven. The band saw grinders, two circular saw sharpeners, as well as stretchers, clamps, swages, brazing forges and shears were supplied by the William Hamilton Co., Peterboro. The filing room is suspended directly over the band saws on 30-inch steel bridge trusses. The casings of the band mills are made of ten-gauge iron sheathing and all the spouts delivering refuse to the conveyors are of the same thickness. The mill conveyors are steel troughs supported by strucural steel legs and angles.

Another item of interest is that all lumber is stamped on one end when travelling past the trimming saws, by a Johnson automatic stamp hammer, the trade mark of Gillies Bros. being a G inside a tri-angle.

There is in connection with the economically operated and efficient mill of Gillies Bros., steel stairways and a steel bridge across the whole mill from which vantage points an excellent view is obtained of all the operations on the sawing floor. The lighting is admirable, there being an abundance of wire glass windows, set in steel sash, and large skylights wherever required. The mill has also well laid-out machine, repair and blacksmith shops which are in separate buildings. The latrines for the mill employees are kept scrupulously clean and sanitary and are automatically flushed.

# Experiences of an Engineer in Sewer Construction

### Topic of Mr. A. G. Dalzell's Paper Presented at the Nov. 3 Meeting of the Toronto Branch E. I. C.

For the November 3 meeting of the Toronto Branch of the Engineering Institute of Canada, a report of the Committee on Engineering Ethics was expected, but as the committee had not completed their work, the executive asked Mr. A. G. Dalzell, M.E.I.C., to give a paper on "Some Experiences of an Engineer in the Construction of 140 Miles of Sewers in Vancouver, B.C."

Mr. Dalzell's paper was not given with the object of discussing technical problems in design or construction of sewers, but to give the student members an idea of the problems that were presented to a sewer engineer in a rapidly growing city. The paper was illustrated by numerous lantern slides showing the work carried out, from temporary lumber sewers to the largest trunk sewers with tidal outfalls.

Beginning with the earliest history of Vancouver, the lecturer traced the growth up to the present time, and illustrated by diagrams the growth in population and assessment values as compared with the prairie cities and the older cities of Ontario. He pointed out the effect on sewer design of different methods of land subdivision, and gave several examples of the cost of sewer systems in different areas.

The necessity of securing accurate records not only of the total and seasonal precipitation, but of the intensity of rainfall was shown, and by the courtesy of Mr. H. A. Brazier, the city engineer of London, Ont., the lecturer was able to show a slide illustrating the intensity of the rainstorm that occurred in London on July 15th of this year, compared with the greatest intensity recorded in Vancouver, B.C.

The waterworks system of Vancouver was outlined and the relation of water supply to sewer design indicated. Also the necessity of studying the distribution of population and the impermeability of surfaces as affecting sewer design. The lecturer then passed on to illustrate various examples of sewer design from the large basket handle or horseshoe sections of area greater than 10 feet diameter circular, to the smaller circular brick and concrete sewers and pipe sewers.

Tabulated costs were given of much of the work carried out both by hand and machine labor, and striking illustrations were given of the heavy cost involved when labor was disorganized by the employment of men not used to sewer construction as relief measure.

The lecturer also urged the necessity of engineering organizations taking cognizance of the organization and working of municipal engineering departments and aiding and backing municipal engineers so that they may be enabled to do full justice to the work for which they are employed, pointing out that they needed this support quite as much as the medical officer required the support of the medical profession.

In an interesting discussion which followed the paper Mr. Wynne-Roberts urged the necessity of securing automatic gauges to measure intensity records, pointing out how Ontario, with much less precipitation than the Pacific Coast, had yet far greater intensity of rainfall. Mr. Goedike gave illustrations of some of the difficulties of the sewer contractor in the city of Toronto, and urged the importance of the engineer being allowed to revise the location of a sewer line or alter the grade when exceptional conditions were met with.

Mr. George Clark, chairman of the branch, opened the meeting and introduced the lecturer, but, having another engagement, vacated the chair in favor of Mr. M. V. Sauer.

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## Short Highway Courses at University of Michigan

During the winter period of 1921-1922, the University of Michigan will offer the following courses for mene engaged in the practice of highway engineering and highway transport. These courses will be given in periods of two weeks each. A man may take one course or a group of courses. For further information, write A. H. Blanchard, University of Michigan, Ann Arbor, Michigan.

December 5 to 16, 1921

Earth, Sand-Clay, Gravel and Broken Stone Roads.
American and English Highway Transport Methods.

December 19 to 31, 1921

Highway Engineering Financing, Management and Organization.
Highway Transport Legislation and Traffic Regulations.

January 2 to 13, 1922

Grading Machinery and Operations.
Interrelationship of Highway, Railway and Waterway Transport.

January 16 to 27, 1922

Bituminous Surfaces and Bituminous Pavements.
Highway Transport Costs and Record Systems.

January 30 to February 10, 1922

Mechanism, Operation and Maintenance of Motor Trucks, Tractors and Trailers.
Highway Laboratory Research.
Highway Structures.
Highway Transport Management.

February 20 to March 3, 1922

Highway Transport Economics and Surveys.
Brick, Cement-Concrete, Stone Block and Wood Block Pavements.
Highway Specifications, Contracts and Jurisprudence.
Highway Engineering Seminar.
Highway Engineering Theory and Design.
Highway Transport Seminar.

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## Under-water Concreting on Johnson St. Bridge Victoria, B.C.

In our October 26 issue, page 931, appeared an article outlining the progress on the construction of the Johnson Street Bridge, at Victoria, B.C. We have been advised by Mr. F. M. Preston, city engineer of Victoria, that the description of the special method of under-water concreting (which is being patented) was not outlined in sufficient detail to enable our readers to properly appreciate the value of the device and its operation. In a future issue the scheme will be described more fully.

# Improvements to the Petrolia Water Works Recommended in Report

## Consulting Engineers Advise Changes in the Present System Which is Now Operating to Capacity—A Metered Service Considered Desirable to Cut Consumption

Petrolia secures its water supply from Lake Huron through an intake located near Perch Village. The intake is 12 miles north westerly from Petrolia. The water flows by gravity through a 12-inch intake pipe into a pump well 14 inches in diameter and about 26 inches deep. From this well the water is pumped by means of steam pumps through a 12 mile 12 inch C. I. force main to the standpipe at Petrolia. There are two steam pumps which may be described as follows, both pumps being made in 1897.

A compound duplex pump manufactured by the Hughes Steam Pump Company and a cross compound fly wheel pump made by the London Machine Tool Company, both pumps having a capacity of one million gallons per twenty-four hours. The steam for these pumps is supplied from two 72 inch diameter steam boilers, each having 68 tubes, 3½ inches in diameter by 16 feet in length.

The standpipe in Petrolia is 25 feet in diameter and 85 feet high and contains about 260,000 Imperial gallons. From the standpipe watermains from 4 inches to 12 inches in size carry the water to the various districts of the town.

No treatment is given the water and tests show that the water is of good quality and safe for human consumption. The absence of typhoid in the town is a clear indication that the water obtained from the lake is first class in every respect.

The plant was built in 1897 under the direction of Mr. Willis Chipman, consulting engineer.

### Purpose of Report

It is the intention of this report to describe ways and means to increase the efficiency of the pumping station, to produce more water and to raise the pressure in the mains throughout the town.

### Pipe Line

The size of the pipe line from the pumping station to the standpipe is 12 inches. At the time of constructions of the plant, there was considerable debate as to the advisability of building a 12-inch main as against a 10-inch main. Referring to Mr. Chipman's original report, the capacity of the 12 inch main is given as 900,000 gallons per day and a 10 inch main as 750,000 gallons per day. Figures were also given showing the loss due to friction in these pipelines, and the construction of a 12 inch main was urged and very wisely adopted by the municipal authorities of that date. The consumption of Petrolia today is approximately 1,000,000 gals. of water. It can readily be seen, then, that the plant has reached the capacity for which it was designed.

It is interesting to make a study of the loses in this pipe line due to friction. There is a static head, or in other words, there is a difference of elevation from the lake to the top of the standpipe of 173 feet. Pumping one million gallons per day through the pipe line requires an additional head of 11 feet in order to overcome the friction. This gives a total head to the overcome of 289 feet or 125 lbs. pressure.

If 1,000 gallons per minute were pumped through these lines, namely, 1,500,000 gallons per day, the friction head to be overcome would be 255 feet or a total head of 398 feet which represents a pressure of 175 lbs. per sq. inch. You will readily realize that this pressure is a very high pressure to put upon your 12 inch main.

If a large reservoir were constructed at the summit, which is 18,000 feet northerly form the town, the total head to be pumped against, assuming that the elevation of the water in the reservoir at the summit would be the same as the standpipe in town, would be, for 1,000 gallons per minute, 338 feet or 150 lbs. presure at the pump house. If this reservoir were constructed as suggested above, there would, of course, be a loss in pressure due to friction from this reservoir to the town of approximately 60 feet if 1,000 gallons per minute were being delivered. Assuming, however, that the standpipe in town would become filled during the night's pumping, there would be an equalizing effect between the two reservoirs, which would probably give at least a pressure of about twenty-five pounds in the town. In case of fire the pipe line could be called upon to deliver 1,000 gallons per minute to the fire engines even if the tank in town were at a low level and if the tank in town were nearly filled, there would be available a discharge for some time considerably greater than 1,000 gallons per minute.

Having the above fact in mind, you will appreciate that 1,500,000 gallons per day is the limit of the capacity of your force main and efforts should be made to conserve the consumption of water in Petrolia in order that the time for the duplication of this force may be placed as far in the future as possible.

### Water Consumption

It is interesting to note Mr. Chipman's recommendation of 1895 re the conservation of water and we take the liberty to quote from his report the following paragraph:

"The general adoption of meters is equivalent to doubling the capacity of the works and will thus postpone the necessary enlargement of the pumping plant or duplication of the force main."

In his report he states that without meters a 10 inch main would supply a population of 6,000 and a 12 inch main a population of 9,000 and that with meters, the figures would be 10,000 and 15,000. Having regard for the fact that the population in Petrolia today is given as approximately 3,000, the consumption of water, namely 1,000,000 gals. per day is far in excess of the amount for which the plant was designed. There is no question that a large amount of water is being wasted in Petrolia and if this water was conserved, the plant could be operated at a material saving and the necessity of duplicating the force main would be postponed for many years. The average consumption of a town for water should not exceed 100 gallons per head per day including industrial water. On a fair estimate, there is being used in Petrolia, the following commercial water: Refinery, 350,000 gallons per day; railways and factories, 150,000 gallons per day; total 500,000, which leaves 500,000 gallons of water consumed by a population of 3,000 or a per capita consumption of 165 gallons per day. This per capita consumption, omitting industrial water, should not exceed fifty gallons per day.

To remedy this condition, we would advise that meters be placed upon all services and that a thorough inspection be conducted of the premises of all water users and that all plumbing fixtures found in bad repair be put in good shape. This is a very serious problem for the Water Commission of Petrolia because if more than 1,500,000 gallons of water per day is required, it will be absolutely necessary to duplicate your present force main, which would cost at today's price no less a sum than $200,000. We believe that if these facts are placed squarely before the water consumers that you will be able to cut the consumption of water in Petrolia nearly in half.

### Pumping Equipment

As stated above, the pumping is done by two steam driven pumps, but in reality the duplex pump does practically all the work of the pump house. This pump is working at the present time in an overloaded condition and for this reason, it is not possible for it to deliver one million gallons per day and fill the standpipe, the pressure in town ranging from 15 to 20 lbs. throughout the system. Owing the high cost of coal the cost of pumping by steam is a large figure. Electrical driven pumps can be placed in the pumphouse that will do your pumping at a figure very materially lower than the steam.

When electrical driven pumps are installed it will be necessary to make provision for an alternative supply of power since electric storms and trouble on the power line from Niagara may at any time cut off your supply. To meet this emergency, one of three methods may be adopted.

(1) Keep pressure in the boilers at all times with banked fires.

(2) Instal gasoline engine driven pumps.

(3) Construct sufficiently large storage reservoir at the summit near the town which would contain at all times sufficient water to provide against a breakdown in the power line.

These three schemes will be taken up later in this report.

### Reservoir on Summit

If a reservoir of 750,000 Imperial gallons capacity were built on the summit there would be enough water to answer the requirements of the Canadian Fire Underwriter's Association. In order to secure full and proper rating from the Underwriter's, it would be necessary to duplicate the 12 inch pipe line from the summit to the town, a distance of 18,000 feet, which would cost approximately $65,000.00. If this pipe line were duplicated, the loss due to friction from the summit to the town would be reduced from 60 feet to 18 feet and the static presure in town while drawing 1,000 gallons per minute from the reservoir on the summit would be 30 lbs. minimum and the average pressure would be about thirty-three pounds. If your municipality can finance this undertaking, it would certainly put your water supply as far as fire protection is concerned in an A1 condition, because you would not then depend on one pipe line for your entire supply of water.

In the original report previously referred to, the question of a reservoir on the summit was dealt with and was referred to as follows:

"To construct a reservoir at the ground level on the high land crossed by the force main about four miles out of town would give storage but no pressure as the loss from friction would be more than the head obtained. A standpipe at that point would require to be higher than in town to give an equivalent fire supply. I cannot recommend this suggested scheme."

The situation today is entirely changed from the condition in 1895 due to the fact that today we require an alternative power unit in connection with the installation of electric pumps and this reservoir now becomes available as an alternative water supply instead of a storage reservoir as considered in 1895.

The distinct advantages of a large reservoir at this point are as follows:

(1) A water supply is guaranteed to the town for twenty-four hours, should there be power troubles on the hydro electric line.

(2) The source of a supply for a period of twenty-four hours is brought within four miles of the town, instead of twelve miles, thus eliminating two-thirds of the danger which is ever present on single pipe lines.

(3) The reservoir would act as a large settling basin in which the water would be allowed to settle for some hours and thus free itself from a considerable amount of silt which at times is present in the water.

The question of the size and height of the reservoir is an important consideration. If the reservoir is constructed at the same height as the standpipe in town and of 750,000 gals. capacity, it would be 35 feet high and 66 feet in diameter. Proper valves, etc. would be provided for the purpose of cleaning out and regulating the height of the water in the tower.

### Typt of Pumps

There are two types of pumps which may be purchased for electric drive, i.e. The centrifugal pump and the triplex plunger pump. The more generally used pump of the two is the centrifugal. Its advantages are; small machine with consequent minimum floor space, no valves to keep in repair or pistons to pack, much cheaper and more easily operated. The advantages of the triplex plunger pump lies in its efficiency which is about 10 per cent. higher than the centrifugal. It is a slow speed pump and has perhaps a greater range in discharge than the centrifugal.

There is sufficient room in the pump house by removing one of the steam pumps to instal two electrically driven centrifugal pumps, but if triplex pumps are installed additional building space will be required.

The cost of both units are given in "estimates of cost."

### Screen Chamber

After the improvements outlined in this report are completed, we would recommend that you reconstruct the pump well and instal a system of screens to clear the water from sea weed, fish, debris, etc. This would be accomplished by constructing a wall, with moveable screens, across the well between the intake and suction pipes. The screens would be arranged to lift out so that they could be frequently washed by a fire hose. The cost of this work would be about $2,000.00.

### Air Valves in Discharge Line

The loss due to friction in the pipe line does not indicate any serious trouble such as air pockets, partially closed valves, etc., but when the greater pressure which is contemplated is inaugurated the line should be carefully gone over and air valves placed at all abrupt changes in grade of the pipe line. From a study of the profile there should be 6 or 8 additional air valves installed.

### Estimate of Cost

We have collected figures on the cost of the various equipment and are satisfied that the following figures represent a fair margin of safety:

| | |
|---|---|
| 2 electric driven centrifugal pumps | $10,000.00 |
| Piping, valves, etc. | 3,000.00 |
| Centuri Meter and Recorder | 1,000.00 |
| 750,000 gal. reservoir and foundation | 20,000.00 |
| Screen Chamber | 2,000.00 |
| Incidentals | 1,000.00 |
| | $37,000.00 |
| Contingencies, engineering | 5,000.00 |
| | $42,000.00 |

For $6,000.00 additional a 1,000,000-gallon reservoir could be constructed. If triplex pumps were installed the additional cost would be $2,500.00 for the pumps and $3,000.00 for additional building space. If one gasoline engine driven unit and one electrical unit were installed add $1,000.00 to the above.

To carry $42,000.00 on a 20-year debenture at 6½ per cent. there would be a yearly charge of $3,800.00.

### Operating Costs

The operating costs of your present plant as shown in your annual statement for 1920, pumping station only, are as follows:

| | |
|---|---|
| Salaries | $3,195.00 |
| Supplies | 714.06 |
| Repairs to plant | 2,684.39 |
| Fuel | 12,496.13 |
| Telephone | 199.27 |
| Hires | 116.00 |
| Insurance | 163.65 |
| | $19,568.50 |

These items may be summarized as follows:

| | |
|---|---|
| Salaries | $3,195.00 |
| Supplies, repairs, telephone, insurance, etc. | 3,877.37 |
| Fuel | 12,496.13 |
| | $19,568.50 |

Operation by electric pumps would bring your operating costs down to the following:

| | |
|---|---|
| Salaries | $3,200.00 |
| Supplies, repairs, telephone, etc. | 1,500.00 |
| Fuel for heat | 200.00 |
| Electric energy | 8,700.00 |
| | $13,600.00 |

You will se from the above that there is an annual saving of $5,968.00 on operation, and when the capital cost of the work is deducted there will be a net annual saving in yearly charges of $2,168.00. The cost of banking fire under one boiler would be about $4,000.00 per year, approximately 50 per cent. more than the carrying charges on the reservoir.

### Revenue and Rates

Having the above facts in mind, it will not be necessary to increase the water rates, but rather, when the work is done and in operation you will be in a position to show a yearly revenue rather than the loss that your yearly balance sheet now shows.

### Method of Procedure

Under the Municipal Act, Chapter 192, Section 400-3 R.S.O. power is given the Ontario Railway and Municipal Board to approve of debentures, by-laws and the asset of the electors is not necessary "if it is shown to the satisfaction of the board that the extension is necessary and that sufficient additional revenue will be derived therefrom to meet the annual payments in respect of such debt and the interests thereon."

We would recommend that you proceed under this act and that formal application be made to the board for their approval. Before this is done it will be necessary to submit plans and specifications to the Provincial Board of Health and secure their approval.

### Recommendations

Having the above facts in mind, we recommend that the following matters be taken up by your commission and that steps be taken to prepare the necessary plans and specifications and call for tenders on the same at an early date.

(1) That two electrically driven centrifugal pumps be installed at the pump house and that one steam pump be removed to make room for same.

(2) That the pipe line be gone over carefully and the necessary air relief valves be installed.

(3) That a large reservoir of at least 750,000 Imperial gallons capacity be built at the summit.

(4) That the pump will be rebuilt so that it can be equipped with screens.

(5) That electrical operation be continuous and that the boilers be allowed to remain cold, except for several days in the year when, the steam should be got up in order to turn over the steam pump and keep same in order.

(6) That a systematic inspection and advertising campaign be carried on in order to reduce the consumption of water as much as possible.

(7) That your board seriously consider the advisability of metering all services.

(8) That the necessary plans and specifications be prepared and submitted to the Provincial Board in order to legalize the issuance of debentures to cover the cost of the work.

(9) That as soon as financial conditions will permit that you duplicate the pipe lines from the summit to the town. This could likely be easily managed when payments on your present debentures are completed in a few years.

All of which is respectfully submitted.

James, Proctor & Redfern, Ltd., Toronto.

## ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE TO MEET IN TORONTO

The seventy-fourth meeting of the American Association for the Advancement of Science will be held at Toronto, Canada, by invitation of the University of Toronto and of the Royal Canadian Institute. While it is not to be expected that the Toronto meeting will attain the great magnitude and complexity that characterized the recent Chicago meeting, yet it is certain to be exceptionally satisfactory in many ways. Not being one of the larger, four-yearly meetings, which are scheduled to occur in rotation, at Chicago, Washington, and New York, the second Toronto meeting will be simpler, with fewer serious conflicts, It will excel especially in opportunities for personal and social contact among those in atendance, a very desirable and valuable feature of the Association meetings that is necessarily partially thrown into the background at the great four-yearly meetings.

Dr. J. C. Fields, F. R. S. professor of mathematics, University of Toronto and president of the Royal Canadian Institute is chairman of the local committee for the Toronto meeting 1921 of the American Association for the Advancement of Science. Mr. H. L. Seymour, C.E., is the secretary, with address the Royal Canadian Institute, 198 College Street, Toronto, Ontario.

# Playing Safe on the Construction Job

## How One Construction Organization Kept Down the Number of Accidents and Minimized Lost Time—Foreman Responsible for Safety Measures

By P. B. Easterbrooks, Superintendent of Construction, Dwight P. Robinson Company, before Congress of the National Safety Council.

Construction forces of Dwight P. Robinson & Company, Incorporated, started work in extensive improvements to the East Side plant of the American Rolling Mill Company at Middletown, Ohio, in July, 1919, and completed their job in April, 1921, twenty-two months later. These betterments, costing over four million dollars and requiring a field labor payroll alone of over a million and a quarter dollars, were carried out under the direction and supervision of the client's consulting engineer, Mr. Daniel Eppelsheimer, who stimulated and encouraged our best efforts, looking toward the safety of our men. We were also materially benefited by the lively concern felt by the president of the American Rolling Mill Company, Mr. George M. Verity, in all matters affecting the welfare or happiness of our forces.

So at the outset, it is probably best to call to attention and emphasize the friendly and hospitable atmosphere in which the construction forces found themselves, for it immediately made available the most helpful assistance of the seasoned and wonderfully efficient Armco safety organization, whose operations and records are probably familiar to everyone interested in safety around industrial plants.

The Dwight P. Robinson construction forces at Middletown performed many hazardous operations without a man being killed or sustaining a permanent injury, and with but very few lost time accidents. Moreover, the work was so conducted that not a single mishap occurred to any one of the three thousand plant operatives, who were carrying on production in the midst of the construction operations.

Results such as these could only be obtained by cooperation of the most practical kind and by the kindly help and active assistance of every one down to the humblest employee in and around the work. Time and chance are large elements in all construction, and it is only by obtaining such results as are recorded here that the construction superintendent is occasionally heartened with the enthusiasm so necessary and so essential to the growth of "safety first." Construction is essentially an adventurous occupation, and numbers among its forces far more of the young and careless than are found among the steady, reliable and efficient forces of the stabilized industrial plant.

### Scope of the Work

The betterments mentioned consisted in the main of extensions to the sheet mill and furnace building, unloading and setting up of the machinery in the same, new building for the galvanizing and finishing departments, extending the boiler house and erecting new boilers, together with auxiliary equipment, extending the storage building, building a filter plant and new water softening tanks, installing a water cooling and return system, together with spray pond for the open hearths, erecting a coal handling plant and distributing system for annealing and furnace building.

New 36 in. water main connections and valves were installed at the river pumping station, a new electrical distribution tunnel was carried from power house under the blooming and bar mill building to a new switch house, and extensive additions were made in electrical power and lighting distribution. Steam lines were extended to provide for new pickling machines and for other purposes.

Some of the quantities involved were as follows:

100,000 cubic yards of yard grading.
50,000 cubic yards of foundation excavation.
20,000 cubic yards of concrete were placed.
4,000 tons of steel were erected, riveted and painted.
2,500,000 brick were laid.
3 miles of new track were laid and nearly as much removed.
1 mile of new sewer was laid in deep trench.
1 mile of new road was built.

In general, new buildings with a roof area of over ten acres were erected, together with all the machinery and necessary service and plant facilities which involved the unloading and placing in the work of over 2,500 loaded cars of material.

The able plant management was increasing production month by month (and without the use of new facilities) to a tonnage far in excess of best previous records.

To carry on construction work of this magnitude in the midst of an intense industrial campaign, so that each and every workman felt secure and confident in his safety, was no small achievement, and shows what can be accomplished when large forces really cooperate intelligently. The client's consulting engineer, Mr. Eppelsheimer, would outline and explain his construction progress to the plant management and operating superintendents. After they had considered it and eliminated the objectionable features, it was then taken up with the construction superintendent, who would, in turn, take it up with his assistants and foremen and get their viewpoints of the obstacles to be met and overcome. It is a pleasure to record the fact that the construction forces were usually able to give the plant management the new work as desired on schedule time with no unnecessary hazards.

### Safety Organization of Construction Forces

After a week spent on the job getting acquainted with the assistant superintendents and the foremen of construction forces, and discussing plans for co-operating for safety with Mr. Adair, safety engineer of the American Rolling Mill Company, Mr. Davidson safety engineer of Dwight P. Robinson & Company, Incorporated, outlined a scheme along lines developed by the members of the National Safety Council, which was both comprehensive and flexible enough to successfully meet all of the changing conditions afterwards encountered as the work progressed.

A meeting of all the foremen was called by the superintendent, at which the value of a safety organization was explained and plan was launched on a working basis. The first step was the selection by the superintendent of three foremen for the first foremen's safety committee.

Two other committees of three each were formed by the ranks of the mechanics and construction laborers, respectively, but they never did function properly, since they seemed to have no common ground for meeting, nor any general interest in the job. Moreover, with the terrific labor turnover obtaining throughout all industry at that period, often the men selected did not remain on the job for two pay days in succession, or long enough to perpetuate the committee. After struggling with these condition for a while, it was decided by the foremen to abandon the idea of any help from the rank and file, and they agreed that it was up to them to make the job safe. This responsibility they assumed voluntarily, and with few exceptions were at all times on guard against accidents.

The organization of the foremens safety committee was designed to secure, in turn, the benefit, advice and active assistance of every foreman on the job. One member was made permanent chairman and the other two members served four weeks as active committeemen. Every two weeks one man retired and the committee selected another from among their fellow foremen to serve. Thus, the personnel of the committee was constantly rotated by bringing in one new member at a time every two weeks. At 2 p.m. each Tuesday the safety committee made a thorough inspection of the job. Any conditions or practices which the committee deemed unsafe that were observed during the inspection of the job were immediately taken up and discussed with the foreman directly in charge of the particular operation, and appropriate remedial measures were recommended. All such recommendations were incorporated in an inspection report which was submitted at a fortnightly general safety meeting.

### General Safety Meeting

Every other Wednesday at 3 o'clock a general safety meeting was held in the field office, at which all superintendents, foremen and engineers were present. These meetings, though short, usually lasting from forty-five minutes to one hour, were directly to the point and a good deal of business was transacted. A report was read showing the accidents, classified as to cause, which had happened since the previous meeting and a discussion carried on as to the best means to prevent a recurrence.

Frequently papers regarding safety were read by assistant superintendents and general foremen in charge of the various sections. Time was always set apart for a short round table discussion at which any one present brought up any particular accident problem that he might have on his mind. The inspection reports of the foremen's safety committee were also read and the different foremen concerned were questioned as to whether recommendations had been carried out. It is a notable fact that in but two instances was an appeal taken to the superintendent from the rulings and recommendations of the safety committee. We cite this to show the intelligence and spirit of fairness that actuated these foremen while temporarily in authority.

For one period of two weeks there were no unsafe conditions of any kind observed, and on several occasions inspections were made and the whole job given a clean bill of health. Some of the foremen kept their names off lists for months, while others, on account of constantly changing personnel, found their names on every report for months.

But the foremen's safety committee, with its inspection and reports every week aided by the general safety meeting every two weeks, did tie the whole job up to one standard of safety, and by its weekly reports to the New York office, kept alive and circulating the interest in this movement. This, together with frequent visits to the job by Mr. F. H. McGraw, construction manager, furnished the impulse necessary to carry the job over some particularly strenuous campaigns, where otherwise safety might have been relegated to the background and its importance perhaps lost forever.

The figures representing the accident experience on this work are as follows:

### Accident Frequency Rate

Number of lost time accidents per 100,000 man hours worked, 3.3.

Number of working days lost per 1,000 men hours worked, 0.4.

These rates are calculated in accordance with the standard practice of the U. S. Bureau of Labor statistics and the National Safety Council.

One of the outstanding features in connection with our safety work was the important consideration given by the foreman to the placing of a "newly hired man." The care taken by some foremen in making a man appreciate the nature of the work to be undertaken, making him acquainted with his immediate associates and watching him carefully in places of possible danger, gave him a sense of security and a feeling that his personal welfare was being looked after, the value of which is hard to over-estimate.

### Conclusion

In concluding, we quote from a report made by the chairman of the safety committee after the plan had been in operation about six months: "There has been a great change in the feeling among the foremen toward the safety movement since its inauguration here. Many of us were openly dubious as to its success, but now every one takes a sincere interest in it and cooperates heartily with the safety committee, making suggestions and carefully safeguarding the men under them. Only by these methods can 'safety first' succeed."

That the men themselves were alive to the safety movement is best shown by the name given to the safety committee by one of the negro laborers, calling it, as he did, the "Do Good Committee."

## New Equipment for Montreal Water Works

Additions to the pumping and distributing system of the Montreal waterworks have been approved and a contract has been awarded to the Dominion Engineering Works, Limited, for the following principal items:

Three electrically-driven centrifugal pumps, to operate against a head of approximately 250 feet, and to have a capacity each of thirty million gallons per 24 hours.

Twelve 36-inch Johnson hydraulic valves, of the automatic check and stop type.

Six 42-inch suction gate valves.

The Johnson hydraulic valves are of a special type which will interest those connected with the installation and maintenance of waterworks mains. These valves close automatically, acting as checks, in case of stoppage of the pump. They also close automatically in case of failure of the pipe for any cause on the pump side of the valve, the consequent drop of pressure immediately setting up a closing movement and preventing the escape of water from the system on the discharge side of the valve, through which a large amount of property damage often ensues before the flow can be arrested by ordinary means. The closing can also be done by hand or by motor when occasion requires.

An additional feature of importance is the graduated closing of the valve, which moves quite rapidly at first, but slows down during the final closing, so as to obviate water hammer or shock in the mains. This action takes place in either hand or automatic closing, and is capable of adjustment to suit the conditions in any particular main. It is particularly valuable in systems where many of the mains have been in long service.

A notable example of the Johnson hydraulic valve is to be seen in the course of manufacture, at the present time, in the shops of the Dominion Engineering Works. It is rated as a 20 ft. diameter valve, but the extreme outside diameter is 25 feet. It is the largest valve of this type yet designed, the estimated weight being 365,000 lbs. It will be installed at Shawinigan Falls, Que., under a head of 140 feet.

The Dominion Engineering Works are now taking up the manufacture of special gate valves, as they have facilities for this class of work in the larger sizes.

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## C. G. Porter & Co. Secures Agencies

C. G. Porter & Company have recently opened offices at 603 New Birks Bldg., 10 Cathcart Street, Montreal, and have the following agencies which were formerly handled by Douglas Milligan Company, Limited: Canadian David E. Kennedy; Canadian Jewett Refrigerator Co.; Canadian MacArthur Concrete Pile Co.; Custodis Canadian Chimney Company; Keystone Fireproofing Co. of Canada; Reliance-Grant Elevator Equipment Corporation; R. Gaustavino Company.

# Highway Transport Division as a Part of a City's Administration

### Committee of American Society for Municipal Improvement Recommends the Appointment of a Body to Deal With All Matters Pertaining to Traffic and Transportation on City Streets

At the recent meeting of the American Society for Municipal Improvements in Baltimore, U. S. A., the Committee on Traffic and Transportation submitted its 1921 report as follows:

Investigations conducted during 1921 influenced the committee to strongly urge the general adoption, by municipal governments, of the recommendations embodied in its 1920 report relative to the following subjects:

Use of "dummy cops" at street intersections.

Installation of "rotary traffic" at street intersections wherever practicable.

Design and construction of long radius curb corners.

Economic design of street widths on through thoroughfares in small towns and cities.

Utilization of by-pass highways for towns and cities located on important national, state, and country trunk highways.

Consideration of the installation of motor bus routes in municipalities, when an extension of the public passenger transportation system is required, in view of the resulting advantages of such installations from the standpoints of maintaining the maximum practicable traffic capacity of streets and of avoiding the use of car tracks in roadways.

Based on a careful analysis of public passenger transportation, your committee considers that it is highly desirable, from the standpoints of economic public service transportation and the efficient use of municipal streets by traffic, that the society should strongly condemn the development of "wild cat," so-called "jitney" service. Not only is the installation of such service undesirable from the standpoint of the overcrowding of streets with five-passenger public transportation vehicles, but it is obviously unfair to public service corporations, operating under franchises, to be forced to compete with a "jitney" service which almost universally is operating on an uneconomic basis. The present overcrowding of some of the principal thoroughfares of the city of Detroit with hundreds of five-passenger "jitneys" furnishes a striking example of this type of public service transportation development.

Your committee recommends that a highway transport division should be installed in engineering or highway departments of municipalities having a population of over 100,000. The duties of this division would be to deal with all matters pertaining to traffic and transportation which affect the economic design and maintenance of streets and their efficient use by pedestrians and all classes of vehicles.

One of the important functions of such a division would be to make highway transport surveys as preliminary to the design and reduction of streets, the determination of efficient methods of maintenance and the formulation of recommendations pertaining to efficient traffic regulations.

A highway transport survey embodies all investigations in the field and office which are necessary to determine the probable amount, character and effects of the future traffic which will use a given highway during the lives of its several component parts. Such a survey for a given street may cover a consideration of all of the following factors: First, all highway elements which affect economic highway transport; second, legislation relative to franchises and rates, weights, dimensions, and speeds of passenger cars, trucks, tractors and trailers; third, state and urban traffic regulations; fourth, vehicular and population statistics; fifth, traffic censuses of motor and horse-drawn vehicles and cars operating on tracks; sixth, vehicular operation as affecting roadways and other parts of highways; seventh, present and future traffic and commercial transport developments in such fields gravel and sand pits, oil fields, lumber tracts, fisheries, as agricultural and dairy farming, mines, quarries, plants, factories, wholesale and retail stores, parks and parkways, summer and amusement resorts, and real estate improvements, which affect or will affect the traffic on the street under consideration; eighth, common carriers such as steam and electric railroads and waterway transportation companies and their relationship to street traffic; and ninth, the characteristics of the methods of highway transport such as street car, rural, interurban and urban motor-bus operation, municipal haulage, long and short general rural haulage, rural motor express, inter-city haulage, inter-city express, and horse transport.

Men assigned to a highway transport division should be experienced highway engineers who have or are rapidly acquiring a knowledge of the following subjects: City planning, highway transport economics, legislation, surveys and methods; highway transport management, including delivery systems, scheduling and routing; traffic regulations; inter-relationship of highway, railway and waterway transport; port, terminal and warehouse facilities; and the fundamentals of the mechanism and operation of automobiles, motor trucks, tractors and trailers.

The committee which presented the above report consists of Arthur H. Blanchard, chairman; Robert Hoffman and Charles O. Boyd.

# Construction Methods on Holeproof Hosiery Company's Plant

## Concreting and Forming Operations—Buggies Considered More Economical Than Chuting—Floors Not Laid on Sleepers

In addition to the information contained in the description of the Holeproof Hosiery Company's factory in our last issue, the following notes have been supplied relative to the construction methods employed on the job. We are indebted to Mr. H. P. Elliott, consulting engineer, for the data.

The soil where this building is located is what we call London clay, and in this particular locality, comes within three or four feet of the surface. It is a mixture of clay and sand, and is very hard to handle when wet. We are, however, allowed to load it up to about two tons per square foot for the foundation work. By thoroughly draining the excavation as we went down, we dug the whole basement by means of a steam shovel very rapidly and without any particular trouble. We also excavated the sub-basement for the boiler room in the same way, but had to use sheet piling for this. The column footings had to be excavated by hand and the contractor had no particular trouble after making proper arrangements for drainage.

The aggregate for the concrete used in the footings was bank gravel of a very good quality obtained on the outskirts of this city. For all the reinforced concrete work, however, we used crushed rock from the Dundas quarries, and this was brought in to a railroad siding on the street beside the building.

The concrete mixer was furnished by the London Concrete Machinery Co., and was placed in the excavation afterwards used for the coal pocket. All sand, gravel and broken stone was teamed either from the cars or from the pits and drawn up onto a platform over the mixer. Dumping wagons were used for this teaming and the material was dumped through holes in thep latform into large bins, where it was fed by gravity into the mixed below. The concrete after being mixed was hoisted by an elevator tower to the various floors where it was dumped into buggies. We thoroughly considered the question of spouting the concrete directly from the tower, but figured that the buggies were cheaper on a job of this size. By handling the material in this way, practically the only labor required was in handling theb uggies. There were no special difficulties encountered.

In regard to the form work, the only unusual feature about this was that complete drawings were made for all the form work which was specially designed with as much care as if it were a permanent part of the building and was so designed that certain parts could be removed from underneath a floor after that floor was poured and used again for the next floor, still leaving enough supports to safely support the floor previously poured.

In putting on the brick veneer, we used scaffolds all hung from the roof, and which were drawn up by means of pulleys as the work progressed. I have never noticed these used in this city before, and we found them great time savers. The people that supplied these scaffolds and operating mechanism also sent a man to take charge, who erected them and operated them, and finally removed them when the job was completed.

It might be of interest to note that the wooden floors of this building, instead of being laid on sleepers with a cement fill, were constructed as follows: A one-inch blanket of sand was first laid on the concrete slab. A $\frac{7}{8}$-inch maple floor was nailed on these planks and running crossways of the building. This floor has given great satisfaction and has shown no tendency to creep, and, as all the butts are supported by the planking beneath, we think the floor will wear longer and give more satisfaction than if laid on sleepers.

# How a Construction Revival Can Relieve Unemployment

## A Memorandum Submitted to the Recent Unemployment Conference Held at Washington, D. C., Analyzes the Present Building Situation and Suggests Measures to Keep Things Moving

By R. C. MARSHALL, General Manager, Associated General Contractors of America

In the present situation the well-known slogan "build public works in times of depression" is again advocated, and this principle should be carefully investigated, to determine its possibilities as a remedy for unemployment. If construction in conjunction with other measures is advisable, the ground should be cleared for putting it under way. But before such action can be successfully carried out, the co-operation of public officials, industrial leaders, and the public at large must be secured. This means that they must see exactly how construction is able to give relief.

To show the feasibility of starting industrial recovery and giving employment by inaugurating construction (both public and private work), an analysis of the five fundamental factors is prsented. They are:

1. Dependence of other industries upon construction for a market.
2. Present shortage and the demand for construction.
3. Capacity to increase employment.
4. Causes delaying construction.
5. Steps necessary to revive construction.

The factors vitally affecting the present unemployment emergency are here briefly outlined.

### Dependence of Other Industries

Construction holds the position of a key industry through which the products of some forty other industries find their way to a consumer, and the innumerable items of materials and equipment produced by them converge to a narrow outlet, governed by construction operations. Therefore, when these operations are stopped they block the outlet for hundreds of products and intensify in the basic industries the effect of unemployment.

Steel and lumber production especially suffer when construction becomes stagnant. Before either of these can again give employment to the usual number of men, orders for structural members, lumber and other products used in the many branches of construction must be received. This principle acts also in all of the 40 basic industries, and in these industries more than in construction itself, the capacity to provide employment lies.

### Present Shortage of Construction

There is a potential demand for both private and public works, which can by proper action be converted into a commercial demand for materials and labor, a value upon which has been placed by numerous agencies. Reliable statistics for such estimates are meager, but the main items of these various estimates show close agreement. The need for mercantile and industrial buildings which is obviously synchronized with the trade cycle is low. But the requirements of housing, public utilities, and various types of public works undoubtedly need an intensified building program for several years to come. The railways, according to Mr. E. H. Harriman's estimate some years ago, lacked construction to the amount of five billions, practically none of which has yet been attempted. An immense expenditure represents the needs of our public utilities, and according to the plans laid for highway development, a vast amount is needed for public roads.

### Capacity to Increase Employment

The number of employes in the basic industries engaged in producing construction materials, products and equipment was recently estimated by the United States Chamber of Commerce to be one-fourth of the employes engaged in manufacturing and mechanical work. Probably one-eighth of those in mining and transportation also depend upon construction. If these figures, commonly accepted in the absence of accurate statistics, are correct, the ratio between labor in the basic industries and in construction is about two and one-half to one. This indicates that when two men are set to work in the field, seven men are employed in the whole construction group.

In the present emergency not only the number of men, but also the time required to place them at work, is important. For an estimate of this we can rely only upon the judgment of men experienced in construction operations.

Seasonal considerations and the lack of preparation in matters of design and plans make it impossible to start immediately all work for which public appropriations have been provided. But if a major part of this work is started in November, if this conference can influence private agencies also to start work by then, it is estimated that within 90 days employment could be found for nearly a million men.

[This, of course, applies to the U. S.—Editor.]

Both private and public work have been delayed primarily on account of high construction cost. This cost has been brought about, not only by advance cost of labor and material, but also by increased freight rates and heavy financial charges.

### Labor and Materials

Government index building material prices reached a level of 341 in 1920, while construction labor advanced to the index of approximately 230. Comprehensive figures are not available, but both of these are believed now to be in the neighborhood of 160, though union labor is higher. It should be remembered, however, in considering these index numbers, that prices were steadily increasing before the war at the rate of 2½ per cent. a year and would probably have landed without the war at what is now 120. The present level is, therefore, some 40 points above what we would choose to designate a normal. The index of finished construction, as indicated by industrial buildings, stood between 160 and 170 in July, and is now between 150 and 160. The index curve has stopped its descent and immediate deflation is apparently at an end.

It should be noted that wages have kept in step with the per capita increase of money. Whether this relation must necessarily continue is a mooted question, but as the present per capita wealth is some 60 per cent. above that of 1914, it appears that a wage level of 160, as predicted over a year ago by one economist, is at a stabilizing point. In any event, upon this index principally depends any great reduction of cost. Any saving that might be made by lower labor and materials cost will undoubtedly be insignificant compared with the expense of any system of charity or doles that might be necessitated by further postponement of work.

If construction is delayed until producers in the basic industries are driven out, recurrence of the situation of 1920 may be expected. The supply of material will be so slow that prices may move rapidly upward when revival does take place. We shall doubtless be forced to look outside the field of actual labor and materials cost to find a means of bringing about the immediate reduction which will influence the demand for construction in the present emergency.

### Freight Rates

Freight rates on bulky construction materials are a significant factor of increased costs. Their present level has not altogether discouraged shipping and construction, but has in some localities practically killed the aggregate market. Rate discrimination against construction materials was made by the Railway Administration during the war, and on top of its purposely prohibitory rates the last horizontal increase was added. These rates have placed the transportation cost of materials on an 18-ft. concrete highway as high as $11,000 per mile. In specific localities the rates are as much as 129 per cent. above the 1917 charges. They are unduly keeping up the cost of construction and preventing its revival.

### Financing Charges

In every section of the country owners have declined to start new projects on account of financing charges. Both the interest rate and the premium paid for floating loans are discouragingly high. Premiums for floating loans, varying between 10 and 20 per cent., are charged in addition to 7 or 8 per cent. interest. For example, before the first work of construction was begun, the owners on a well-known Washington apartment house were required to pay for the $1,250,000 involved an interest rate of 7 per cent., a bond premium of 1½ per cent. and a floating charge of 10 per cent., making the total financing charges 18½ per cent. Financing charges on a subsequent loan of $250,000 for the same structure were $75,000. This is a charge of 30 per cent. It is doubtful whether the architect, the contractor and the producers in the basic industries made a profit all combined equal to these financing charges. When an owner must pay such a sum before construction even starts, many projects are postponed or abandoned. Before private work can proceed as needed, some relief from conditions must be secured.

### Steps for Reviving Construction

Certain direct action which will open up employment through construction can be taken by the government, while through regulatory action and example it can both stimulate the demand for construction and influence other agencies to act. The following steps to bring about activity in both private and public works are suggested:

(a) Place under construction as soon as possible all federal public work for which appropriations are already made, at the same time urging state, county and municipal bodies to do likewise. In doing this the federal authorities should adhere to existing precedents for administering public works, especially public roads. The efficiency and ability of the bureau of public roads, which have been thoroughly demonstrated and have secured the confidence and co-operation of the states, must not be wasted by vesting construction administration in some other agency. Economical road building requires the specialized engineering ability now centralized in the bureau of public roads.

(b) Enact any necessary appropriations that are already contemplated.

(c) Establish some form of home loan agency, possibly using the postal savings funds, to furnish money at reasonable rates for housing construction, making it possible for the agency to co-operate financially with reliable building and loan associations. Financiers will not turn from attractive foreign loans to place money in construction at lower rates of interest.

(d) Adjust any freight rates on materials that are eliminating markets or causing unreasonable charges on construction materials.

(e) Make payments of claims due the railways and settle other existing claims so that these agencies can undertake immediate improvement and new work.

(f) Push investigations of unlawful or injurious combinations and agreements in finance, building and materials production.

(g) Encourage private agencies by tax exemption to start their projects in the near future; this plan advocated by Senator Calder proved successful in increasing housing facilities in New York. Also advocate drawing contracts to give such owners the benefit of price reduction.

(h) Place the federal power commission in a state to function properly so that private power prospects can be passed upon and put under way.

The factors here mentioned are viewed from the standpoint of construction, and obviously any action pertaining to them must be taken with due consideration for the entire economic situation. We know, for instance, that the railroads must be allowed to rehabilitate themselves and that to do so they must operate at a profit. But in the event that stimulation of construction, either private or public, is brought about by this unemployment conference, such stimulation may be relied upon to aid effectively the present situation.

However, before artificial stimulation is attempted, one vital contingency must be taken into account. This is the effect of sudden expansion upon construction material prices. Unless constructors, material producers and labor are willing in this emergency to accept reasonable profit and reasonable wages, any intensified construction program may end in disaster. If the supply and demand for construction service, materials and labor are permitted to constitute the sole governor of prices, a situation analogous to that of 1920 may reoccur. Since we cannot and should not attempt to arbitrarily regulate prices, assurance of reasonable prices must come from two sources. These are first, the far-sightedness of industrial leaders who know the ultimate benefit of steady prices, wages and markets; and second, the force of public opinion. It is with these considerations in mind that stimulation of construction is recommended.

# Building Bridge Piers on Rock in Shallow Water

## The General Procedure to be Followed in Cofferdamming, Unwaering and Concreting

Short span bridges often need to have their concrete abutments or intermediate piers carried down to footings on rock bottom in shallow water or under a few feet of earth close to the river, where the ground is saturated and water flows freely below the river level.

In such cases the contractor is sometimes unduly discouraged because he is not familiar with work below water level and ordinary excavation and sheeting will not keep the site of the pier dry. If the bottom is very irregular or the current swift, the work may prove difficult and expensive, but under ordinary conditions of still water not more than 3 or 4 feet deep and having a smooth regular bottom, the footings can generally be put in satisfactorily without excessive costs or delay.

### Earth Cofferdams

If the contractor has work on the same job or nearby involving drainage or other excavation that produces waste spoil, almost any kind of material excepting large stones and boulders can be used to form the cofferdam enclosing the footings.

In rare cases where local conditions and topography are favorable it may be possible to make a cut off, or by-pass the water around the site by building dams across the channel above and below the bridge location and turning the flow of the stream through a new channel cut for this purpose or through a pipe or flume discharging into the old bed below the lower dam.

If there is a falls or rapids in the river just below the bridge site it may obviate the necessity for the lower dam and might even provide sufficient head to make it possible to syphon a very small flow through a pipe laid on the surface of the ground and thus greatly reduce the cost of the by-pass if the pipe, which may be of very light construction, is conveniently available from stock or from local sources or can be temporarily borrowed from permanent construction.

Operations should be arranged if possible to be carried on at the time of minimum stream flow when the bed of the river may be naturally almost dry and the trickle of water, that would then accumulate considerable volume if backed up by the dam, may be carried in an ordinary water pipe.

Almost any earth, rock or gravel may be used to give stability to the cofferdam, but unless it contains a suitable amount of fine compactible material it will not be watertight, but it may be placed on the upstream side with a comparatively thin layer of small stones and gravel, filling the interstices of coarser stone and covered in turn with mixed sand and fine gravel, sand, earth or preferably clay, which will generally make the dam reasonably tight.

If there are leaks under the dam or through the fissues in the rock bottom that produce a considerable flow into the enclosed space, it may be possible to excavate a rough channel to carry it to a sump, where a steam or gasoline pump can be installed that will handle a considerable volume of water cheaply.

### Stop Leaks and Pumping

Careful examination may disclose the location of the most important leaks, and sand, clay and even hay, straw or manure may be forced into them and sometimes be successful in closing them. It may also be possible to cover the particularly bad portions of the bottom with canvas held down by a mass of earth or clay dumped over it.

For very shallow water with a smooth, flat bottom a dam can often be made with empty cement bags, three-fourths filled with sand and piled up carefully to form an enclosing wall. This will stop the free flow of the water and will conform closely to the surface of the bottom and when reinforced by clay on the outer face may make a sufficient tight dam, easily built and shifted, that does not occupy so much space or require so much material as a dam of loose earth.

If the current is swift enough to scour away an earth dam, boxes or cribs of convenient size made of any available timber, or boards, no matter how poor, that will hold together can be arranged close together enclosing the pier, balasted with stone, sunk to position and filled with earth and clay and more earth and clay if necessary dumped around the outside.

If serious leaks occur all over the enclosed area, the latter may be subdivided into one or more smaller areas by successive dams or partitions built across the main cofferdam, leaving small portions of space in which the leakage is much diminished and may be pumped out, one at a time, and the footing placed in them, sealing the leaking bottom and providing a base to which the watertight forms can be attached successively, eventually extending over the full area of the completed foundation.

### Enclosing and Venting Leaks

If large definite leaks are discovered inside the cofferdam and cannot be stopped, a dam can sometimes be built around them, enclosing them and enabling the rest of the area to be unwatered and the footing laid, enclosing the leaks in the well, which can, if necessary, be eventually closed under pressure. For small leaks vertical steel vent pipes may be inserted in the hole in the bottom of the river, preventing the accumulation of water pressure and being held in position by concrete deposited around and protecting them until it has set and has sufficient strength and weight to resist the upward pressure. The footing may then be completed with the vent pipe passing through it and eventually the latter can be filled or closed under pressure and cut off flush with the top of the concrete, thus remaining permanently in position without injury to the structure.

### Submerged Forms

The forms for the piers may be made with watertight panels of heavy boards bolted together through outside vertical corner posts. The lower edges of the vertical walls may be cut to conform as closely as possible with the rock surface. The complete form, a little higher than the depth of the water, should be built on land, assembled complete, floated or derricked to position, centered and sunk with ballast and the bottom sealed or partly sealed with clay dumped around the outside or with a canvas apron attached to the lower edge, extending over the surface of the rock and covered with clay or earth.

### Concreting Under Water

If this does not permit the water to be entirely pumped out, it will probably enable it to be brought down considerably below the level of the water outside, reducing the depth so much that the men can work in it to clean and dress the rock surface if necessary, and to place concrete.

It must be remembered that good concrete properly handled may be placed in the water without injury so that a few inches of water in the bottom of the form is not a serious matter if the work is promptly and correctly handled.

Concrete should never be deposited loose in flowing water, but may be carefully dumped in shallow still water. It is better, however, to deposit it carefully with a bottom dumping bucket or through a trough or tube resting on the bottom that protects it from the water until it is in position. Concrete in heavy paper or burlap bags may be lowered to the bottom of shallow slowly running water and the bags opened by hand after they have reached the bottom and they are then withdrawn, leaving the concrete deposited in position.

### Sealing the Bottom

If the piers are large and the bottom is satisfactory in its natural condition or can be made so by scraping, dragging, etc., under water, the pier may be built with a permanent or detachable form carefully secured in position without any attempt at first to remove the water from the interior.

The form, which can be built on the shore, should be made watertight with gaskets, packing or caulking, and after it is in position concrete, to a depth of a foot or more, should be deposited under water covering the entire bottom, and when it is set forming a shield to exclude the water from the leaks under the edges and through the rock bottom. The depth of this concrete must be calculated great enough so that the mass of concrete will be heavy enough to resist the upward pressure at the bottom, else it may be floated up and broken when the form or cofferdam is pumped out above it. A thickness of concrete a little more than one-third of the distance from the top to the waterlevel outside will suffice for this purpose, and after it has set the form may be pumped out and the remainder of the concrete placed in the dry provided the form has been made strong enough and is sufficiently well braced by the interior pieces to resist the outer pressure, which will be heavy in proportion to the depth of the water.

### Tremie Concreting

If satisfactory provision is made for depositing the concrete under water it will be unnecessary to make a form watertight or brace it heavily, and all of the submerged concrete may be placed by means of a bottom-dump bucket or a tremie. This consists of a moveable steel or wooden tube not less than six inches in diameter, terminating at the top in a hopper. Provision must be made for steadily moving it longitudinally and transversely so as to cover the entire area, and to raise and lower it by a tackle, derrick, or some other convenient method.

The bottom should be temporarily enclosed by an easily removable board or some other device, the tube filled with concrete and lowered until it rests on the bottom. When all is in readiness the bottom of the tube should be opened and the tube raised a few inches allowing the concrete to flow out of the bottom, where it will soon form a heap, sealing the tube so that the flow will cease if the tube remains stationary. Provision must be made to supply fresh concrete to the hopper continually and the tube should be slowly moved back and forth across the form and from end to end, great care being taken to always have it filled and the hopper half filled with concrete to insure a steady continuous flow that prevents water from entering the tube and washing the concrete away. If this is carefully done, the concrete deposited under water should be as good as that laid in the open air. The work of the tremie must be carried on continuously day and night until the full mass of concrete is carried up above water level. If at any time it ceases, the tremie should be immediately withdrawn and the bottom closed, concrete filled in and the original operations resumed, otherwise there is likely to be a poor batch of concrete deposited when the first part of it is dumped into the tube full of water. For tremie work the concrete should be thoroughly mixed and should be rich and as dry as possible. If submerged concrete is allowed to stand a few hours the top will become covered with "laitance," a thick slimy substance that must be scraped or washed away before more concrete is deposited, else it will make a bad weak place and prevent the set and bonding of the concrete placed against it.—From "Public Works."

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## Good Roads Show

The annual meeting and "get-together" dinner of the American Road Builders' Association will be held at the Automobile Club of America, New York, N. Y., on Nov. 15. In the afternoon the officers of the association will render their reports and in the evening the dinner will be held, after which the incoming president and other officers for the ensuing year will be installed, followed by speeches by prominent members of the association.

One of the important matters to be considered at the annual meeting is the coming convention and good roads show of the association to be held at the Coliseum, Chicago, Ill., on January 16-20, 1922. The program committee is now preparing the program for the technical session of the convention and it is expected that by the selection of a comprehensive list of vital subjects to be discussed by prominent road builders, a large attendance of persons from all parts of the country interested in highway development and transportation will be insured. Road problems grow more important as the mileage of improved highways increases and as highway traffic grows in volume; and each year state, county and city officials and engineers attend in greater numbers the annual convention of the association, where they find the solution to many of their problems.

At last year's good roads show there were over 140 exhibits and from present indications this number will be greatly increased at the coming show. In addition to the machinery and materials manufacturers who had exhibits last year, many new firms are making applications for space, thus showing that more generally are manufacturers realizing the value of the show.

The amount of money being expended on highway construction is now greater than that being spent on all other public works combined. The value of road machinery now being manufactured exceeds the total value of all other construction machinery being produced. More than one billion dollars is available in the United States for road construction.

# Water Power Development

## All parts of the World Involved in an Unprecedented Investigation of the Value of Water Power Resources—Uses of Hydro-Electric Energy Rapidly Increasing.

By Prof. A. H. Gibson, D. Sc., before the British Association.

The extent to which the water powers of the world have been investigated and developed during the past decade forms one of the striking engineering features of the period. Although falling or flowing water formed the earliest of the natural sources of energy to be utilized for industrial purposes, it is of interest to note that two-thirds of the water power at present in use has been developed within the last ten years.

The reasons for the revival of interest in this question are partly technical and partly economic.

The technical development of electric generation and transmission has made it economically possible to utilize powers remote from any industrial centre, while a rapid increase in the demand for energy for general industrial purposes and for the many electro-chemical, electro-physical, and electro-metallurgical processes which are now in general use, and whose field is rapidly growing, has provided a ready outlet for all such energy as could be cheaply developed.

The urgent demand for energy to supply the abnormal requirements of the war period, combined with the world shortage of fuel, was responsible for an unprecedented rate of development in most countries with available water power resources, and especially in those countries normally dependent on imported fuel.

Thus in France some 850,000 water horsepower has been put into commission since 1915, and the country now has 1,600,000 horsepower under control as compared with 750,000 before the war. In Switzerland some 600,000 horsepower has been developed since 1914, or is in course of construction, as compared with 880,000 horsepower before the war. In Spain, where the pre-war output was 150,000 horsepower, the present output is 620,000 horsepower and about 260,000 horsepower is now in course of development, while the Spanish Ministerio de Fomento is considering the development of some 2,000,000 horsepower to be delivered into a network of transmission lines covering the industrial parts of the country.

In Italy, schemes totalling about 300,000 horsepower are under way, and it is estimated that the total output will shortly amount to 2,000,000 horsepower. The Government Hydrographical Department is now engaged in gauging and surveying the profiles of the principal rivers, and statistics of available reservoir sites, of lakes suitable for storage and of available horsepower are being compiled.

Japan, which only very recently began to investigate her water powers, has, since 1916, developed over 1,000,000 horsepower, or almost 20 per cent. of her available resources.

In Canada and the United States many large schemes have recently been brought into service, and some extremely large installations are now in course of construction or are projected. Thus the Queenston-Chippawa project on the Canadian side of the Niagara River is intended to develop some 500,000 horsepower, while a projected development of the St. Lawrence River will be capable of yielding 1,700,000 horsepower. In Canada the total development (2.3 million horsepower) in 1918 was almost three times as great as in 1910. In the United States of America the development has increased from something under two million horsepower in 1901, to 5.3 millions in 1908, and to nearly 10.0 millions in 1920.

Rapid as his been the development of water power in the United States in the past, it has been retarded by the fact that the privilege of using the national forests or other public lands for waterpower development has only been granted by the issuing of permits which were not available for any definite period and which were revocable at the will of the granting authority, whether on public or private land, each scheme has required a special Act of Congress, and these Acts could be revoked by Congress at any time. Owing to the uncertainty of tenure there has naturally been some reluctance to invest capital in such undertakings.

By the recent Federal Water Power Act. signed in June, 1920, licenses for such development may now be issued under the jurisdiction of a new body, known as the Federal Power Commission, for a period not exceeding fifty years, at the end of which the license may be renewed, or the Government may take over the enterprise upon compensation of the licensee. In the issuing of licenses, preference is to be given to State and municipal applications. The effect of this Act may be inferred from the fact that, within a month of its being signed, applications for licenses to develop over 500,000 horsepower had been filed. The duty of collecting, recording, and publishing data regarding the utilization of water resources, the water power industry and its relation to other industries, and regarding the capacity, development costs, and relationship to possible markets, of power sites, has also been assigned to this Federal Power Commission.

### World's Available Water Power.

During the past few years much attention has been paid to statistics of available and developed water powers. In the case of developed powers, these are usually stated in terms of the capacity of the installed machinery. This machinery is in general only used to its full capacity over a portion of each day, although in many such cases water is available for providing continuous power if desired.

Estimates of potential power are always to be accepted with considerable reserve. In order to make a reasonably accurate estimate, the run off from the catchment area and the variation in this run off from month to month and from year to year, must be known, and it is only in comparatively rare cases that this information is as yet available. Moreover, there is as yet no standard basis on which potential power is computed.

The power available from a given stream during the wet season is many times as great as during the dry season unless sufficient storage is available to equalize the flow throughout the year, and the cost of such storage would in general be prohibitive, even if it were physically possible to provide it.

The United States Geological Survey takes the maximum useful flow of a stream as being that which may be guaranteed during six months in each year. The minimum flow is taken as the average which can be guaranteed over the two driest consecutive seven-day periods in each year, along with the additional flow which may be obtained during this period of developing any available storage capacity in the upper waters of the stream. Estimates of potential power based on storage capacity are, however, subject to a wide margin of error, owing to the limited data available, and in the following table the potential water power is estimated on the basis of the maximum flow as just defined, in terms of continuous twenty-four-hour power.

**Millions of Horsepower**

| | Available. | Developed. |
|---|---|---|
| Great Britain | 0.9 | 0.2 |
| Canada | 23.0 | 3.28* |
| Remainder of British Empire, including | | |
| Australia<br>Africa (East)<br>Africa (South)<br>Africa (West)<br>British Guiana<br>India and Ceylon<br>New Zealand<br>Papua | 30.0 to 50.0 | 0.7 |
| Austria | 6.5 | 0.57 |
| Brazil | 26.0 | 0.32 |
| Dutch East Indies | 5.5 | .. |
| France | 5.6 | 1.6 |
| Germany | 1.5 | 0.75 |
| Iceland | 4.0 | 1.0† |
| Italy | 4.0 | 1.25 |
| Japan | 8.0 | 1.5 |
| Norway | 7.5 | 1.25 |
| Russia | 20.0 | 1.0 |
| Spain | 5.0 | 0.88 |
| Sweden | 6.2 | 1.2 |
| Switzerland | 4.0 | 1.4 |
| United States of America | 28.0 | 9.8 |

*Including projected extensions to plants now in operation.
†Projected but not yet constructed.

Adopting these figures, it appears that the available horsepower of the world is of the order of 200 millions, of which approximately 25 millions is at present developed or is in course of development.

### Power Available in Great Britain and the British Empire

With the noteworthy exceptions of Canada and New Zealand, practically nothing had been done, prior to 1915, by any part of the British Empire, to develop or even systematically to investigate the possibilities of developing its water powers. It is true that a number of large installations had been constructed in India and Tasmania, but their aggregate output was relatively inconsiderable.

Since then, however, there has been a general tendency to initiate such investigations, and at the present time these are being carried out with varying degrees of thoroughness in India, Ceylon, Australia, South and East Africa and British Guiana. While it is known that there is ample water power in Newfoundland, Nigeria, Rhodesia, Papua and the Gold Coast, no very definite information is available, nor are any steps apparently being taken to obtain data in these countries.

The Water Power Committee of the Conjoint Board of Scientific Societies, which has been studying the state of investigation and development throughout the Empire since 1917, has, however, come to the conclusion that its total available water power resources are at least equivalent to between 50 and 70 million horsepower.

Of the developed power in the Empire, about 80 per cent. is in Canada. Throughout the remainder of its territories only about 700,000 horsepower is as yet developed, or only a little over 1 per cent. of the power available, a figure which compares with about 24 per cent. for the whole of Europe, and 21 per cent. for North America, including Canada and the U. S. A. These figures sufficiently indicate the relatively large scope for future development.

### Power Available in Great Britain

With a view of ascertaining the resources of our own islands, a Board of Trade Water Power Resources Committee was appointed in 1918. This Committee, which has just presented its final report, has carried out preliminary surveys of as many of the more promising sites as its limited funds allowed, and has obtained data from the Board of Agriculture for Scotland, the Ordnance Survey Department, the Ministry of Munitions, and from civil engineers in private practice, regarding a large number of other sites.

As might be anticipated, Scotland, with its comparatively high rainfall, mountainous area, and natural lochs, possesses relatively greater possibilities than the remainder of the United Kingdom, and investigation has shown that it offers a number of comparatively large schemes. Nine of the more immediately promising of those examined by the Committee have an average output ranging from 7,000 to 40,000 continuous twenty-four-hour horsepower, and an aggregate capacity of 183,000 horsepower, while in every case the estimated cost of construction is such that power could be developed at a cost appreciably less than from a coal-fired station built and operated under present-day conditions. The aggregate output of the Scottish schemes brought before the notice of the committee some of which, however, are not commercially feasible at the moment is roughly 270,000 continuous horsepower.

In addition to these, there are a very large number of other small schemes which have not yet been investigated,† and it is probably well within the mark to say that there are water power sites in the country capable of developing the equivalent of 400,000 continuous horsepower, or 1,500,000 horsepower over a normal working week, at least as cheaply as from a coal-fired installation.

A number of attractive schemes are also available in North Wales, though these are in general more expensive than those in Scotland.

Owing to the general flatness of the gradients, there are, except possibly around Dartmoor, no schemes of any large individual magnitude in England, but there are a large number of powers ranging from 100 to 1,000 horsepower which might be developed from river flow uncontrolled by storage.

Investigations on a few typical watersheds throughout England and Wales appear to show that the possible output averages approximately 8 continuous horsepower per square mile of catchment area, which would be equivalent to an aggregate of about 450,000 horsepower. Although much of this potential output is not commercially feasible, it would give the equivalent of 500,000 horsepower over a normal working week if only 30 per cent. of it were fully utilized.

In the report recently issued by the Irish sub-committee of the Board of Trade Water Power Committee, it is estimated that approximately 500,000 continuous twenty-four-hour horsepower is commercially available in Ireland, and that if utilized over a forty-eight-hour working week, its capacity would be at least seven times as great as that of the engine power at present installed in the country for industrial purposes.

It appears, then, that, although the waterpower possibilities of the United Kingdom are small in comparison with those of some more favored countries, they are by no means so negligible as is commonly supposed, even in comparison with the present industrial steam power resources of the country.

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†In a paper read before the Royal Society of Arts on January 25th, 1918, Mr. A. Newlands, M. Inst. C.E., gave a list of 122 potential Scottish schemes, the capacity of which he estimated on a very conservative basis, at 375,000 horsepower.

The capacity of the fuel power plants installed for industrial and public utility services in the United Kingdom in 1907 was approximately 9.8 million horsepower. Allowing for an increase of 15 per cent. since then, and an average load factor of 35 per cent., this is equivalent to 32,000 million horsepower hours per annum, or to a continuous twenty-four-hour output of only 3.7 million horsepower.

According to Sir Dugald Clerk, the average consumption of coal per horsepower hour in this country is about 3.9 lb., which, on the above basis, would involve a total annual consumption of 55 million tons for industrial purposes, not including railways or steamships. This figure is in substantial agreement with the estimate of 60 million tons made for factory consumption in 1913 by the Coal Conservation Committee of the Ministry of Reconstruction, since this latter figure also includes coal used for heating and other manufacturing processes in factories.

Adopting this figure of 32,000 million horsepower hours as the annual demand for power for industrial purposes, it appears that the inland water power resources of the United Kingdom are capable of supplying about 27 per cent. of this, a proportion which in such an industrial country as our own is somewhat surprisingly large.

Many of the small powers would be well adapted for linking up, as automatic or semi-automatic stations, into a general network of electricity supply, or for augmenting the output of municipal supply works, as has been done so successfully, for example, at Chester, Worcester and Salisbury.

The development of the many small schemes available in the Scottish Highlands would probably have a great effect on the social life of the community. It would go far towards reviving and extending those small local industries which should form an essential feature of the ideal rural township. Commercially, such undertakings may appear to be of small importance, but as a factor in promoting the welfare of the State, economical and political, their influence can hardly be overestimated.

Some of the larger schemes in Scotland would lend themselves admirably to transmission to its industrial districts, while others, in close vicinity to the seaboard, would appear to be well adapted for supplying chemical or electro-physical or metallurgical processes.

While this is admittedly an inopportune moment to suggest anything in the nature of State co-operation in such developments, it may be pointed out that many of the Scottish powers in particular occur in sparsely populated districts, and that, although they would ultimately become remunerative, the difficulty of raising the capital necessary for their development is great. In view of their direct and indirect advantage to the community, it would appear not unreasonable to advocate that financial assistance should be granted by the State in the earlier stages of such developments. If such assistance, say, in the form of a loan maturing after a period of ten or fifteen years, could be granted, it would certainly give an immediate impetus to the development of water power in this country.

### Conservation

The importance of water power development from the point of view of conservation of natural resources requires no emphasis. When the value of coal purely as a chemical asset, or as a factor in the manufacture of such materials as iron and steel, cement, etc., is considered, its use as a fuel for power purposes, when any other equally cheap source of energy is available, would appear, indeed, to be unjustifiable.

The consumption of coal in the best modern steam plant of large size, giving continuous output, would be about 9 tons per horsepower year, and on this basis the world's available water power, if utilized, would be equivalent to some 1,800,000,000 tons of coal per annum. The world's output of coal in 1913 was approximately 1,200,000,000 tons, of which about 500,000,000 tons were used for industrial power purposes, so that on this basis 55,000,000 continuous water horsepower would be equivalent to the world's industrial energy at that date.

Not only does the use of water power lead to a direct conservation of fuel resources, but it also serves to a notable degree to conserve man power. To take an extreme example, each of the 40,000 horsepower units now being installed at Niagara Falls will require for operation two men per shift. It is estimated that to produce the same power from a series of small factory steam plants, over eight hundred men would be required to mine, hoist, screen, load, transport by rail, unload, and fire under boilers the coal required, while, if account be taken of the additional labor involved in horse transport, wear and tear of roads and of railroad trucks and rolling stock, the number would be considerably increased.

### Uses of Hydro-electric Energy

While a large proportion of the energy developed from water power is utilized for industrial purposes and for lighting, power, and traction, an increasing proportion is being used for electro-chemical and electro-metallurgical processes. It is probable, indeed, that we are only on the threshold of developments in electro-chemistry, and that the future demand for energy for such processes will be extremely large.

In Norway the electro-chemical industry absorbed 770,000 horsepower in 1918, or approximately 75 per cent. of the total output, as compared with 1,500 horsepower in 1910. Of this some 400,000 horsepower was utilized in nitrogen fixation alone.

The production of electric steel in the U. S. A. increased from 13,700 tons in 1909 to 24,000 tons in 1914, and to 511,000 tons in 1918, this latter quantity absorbing 300 million kilowatt hours, equivalent to almost 400,000 continuous horsepower.

In Canada, in 1918, the pulp and paper industry absorbed 450,000 horsepower, or 20 per cent. of the total, while the output of central electric stations amounted to 70 per cent. of the total.

The electrification, on a large scale, of trunk line railways is also a probability in the not distant future. In the U. S. A., 650 miles of the main line of the Chicago, Milwaukee and St. Paul Railway, comprising 850 miles of track, have been electrified, the power for operation being obtained from hydro electric stations. In France much of the track of the Compagnie du Midi in the region of the Pyrenees has been electrified with the aid of water power; much of the Swiss railway system has been electrified; and the electrification of many other trunk lines on the European continent is at present under consideration.

Quite apart from the probable huge demand in the distant future for energy for the manufacture of artificial fertilizers by some system of nitrogen fixation, agriculture would appear to offer a promising field for the use of hydro-electric power.

Much energy is now being utilized in the U. S. A. for purely agricultural purposes. In California, for example, there is in effect one vast system of electrical supply extending over a distance of 800 miles with 7,200 miles of high-tension transmission lines. This is fed from seventy-five hydro-electric stations, interconnected with forty-seven steam plants, to give a total output of 785,000 horsepower. A further group of thirteen hydro-electric schemes now under construction will add another 520,000 horsepower. A large proportion of this power is used in agriculture, and a census in 1915 showed that electric motors equivalent to over 190,000 horsepower were installed on Californian farms. The Californian rice industry is almost wholly dependent on irrigation made possible by electric pumping, while most of the mechanical processes involved in farming are being performed by electric power.

There can be little doubt that the economic development of many of our tropical dependencies is bound up in the development of their water power resources. Not only would this enable railroads to be operated, irrigation schemes to be developed, and mineral deposits to be mined and worked, but it would go far to solve the black labor problem, which promises to be one of some difficulty in the near future.

While those outlets for electrical energy which are now in sight promise to absorb all the energy which can be cheaply developed for many years to come, there are many other probable directions in which cheap energy would find a new and profitable outlet. Among these may be mentioned the purification of municipal water supplies; the sterilization of sewage; the de-hydration of food products, and the preservation of timber.

(To be continued.)

## Mainly Constructional

**East and West—From Coast to Coast**

The city council at Sarnia, Ont., has decided to make application to the provincial government for a loan of $200,000 under the Ontario Housing Act.

The ratepayers of Stratford, Ont., will shortly vote on a by-law to provide $30,000 for the construction of a bridge over the Avon River.

It is reported that the Builders' Exchange, of Montreal, is considering holding a building supply and furnishing exhibition in that city early next year.

Messrs. Silverwoods, Limited, of London, Ont., it is reported, will shortly commence the construction of a building to cost $75,000, at Chatham, Ont. This firm is engaged in the manufacture of ice and ice cream.

The total value of building permits issued last month at Niagara Falls, Ont., very nearly doubled last year's figures for the same month, the figures being $87,845.26 and $47,200.00, respectively.

Mayor Martin of Montreal recently officiated at the ceremony of turning the first sod in connection with the construction of the Sherbrooke St. viaduct. This structure will be of steel and concrete construction, and will cost about $145,000 to build.

A new firm, to be known as the International Wheel & Rim Co., Ltd., has been organized and is at present occupying temporary office space in the Lumsden Building, Toronto. It is understood the new concern will locate its factory in Toronto and is at present looking for a suitable site.

The city of Verdun, P.Q., reports it has just completed the most successful building year in its history. One hundred and fifty-two permits, representing a total value of $821,115, were issued to October 31, the end of the city's fiscal year, and prospects for the coming year are even brighter than last year's.

Excellent progress is being made on Ottawa's new $2,750,000 civic hospital on Carling Avenue. The framework has been completed to the top of the fifth storey, and it is expected this part of the construction will be entirely completed by Christmas. There are 125 men employed on the job at the present time.

It is reported that next year will see the first oil refinery in Western Canada under operation near Port McMurray, Alberta. A group of Western financial men have secured control of 6,000 acres of tar sands in this district and it is expected a start will be made next spring on the extracting of oil and other by-products from the sands by a new special process.

The London Concrete Machinery Co., Ltd., Cabell Ave., London, Ont., has purchased the business of the Ideal Concrete Machinery Co. of Windsor, Ont., and plant will be removed to London. It has not been decided, as yet, whether it will be operated as a separate firm or in connection with the London Concrete Machinery Co.

Building records for the ten months ending October 31st, in Sudbury, Ont., show construction to the value of $426,910, an increase of $22,000 over the same period last year. Twenty-five houses have been built under the Housing Commission plan this year, and a total of 85 houses in the two years' operation of the commission. The town's allotment of $300,000 under the plan has now been entirely used up.

Ratepayers of Cobourg, Ont., at the coming municipal election, will vote on a by-law as to whether 10 per cent. decrease in assessment on buildings shall be taken off next year, and each succeeding year, until the tax on buildings is completely wiped out. The council will submit this by-law in response to a petition which was signed by more than 200 ratepayers.

At the annual meeting of the Saskatchewan Association of Architects, held recently at the Saskatoon University, Saskatoon, the following officers were elected: President, F. P. Martin, Saskatoon; vice-presidents, W. G. Van Egmond, of Regina, and R. G. Bunyard, of Moose Jaw; secretary-treasurer, F. B. Reilly, Regina; council, Prof. Greig, Saskatoon, W. M. Sharon, Regina, and D. Webster, Saskatoon.

The recommendation of the Board of Works, at Peterborough, Ont., to the city council, that the city purchase an asphalt paving plant, has met with the approval of the latter body. City Engineer R. H. Parsons reported favorably on this undertaking, after having made an inspection of the municipally owned plant at Kingston, Ont. It is not likely the plant will be purchased this year, but the matter will be put into the hands of the new council at the beginning of the year.

A paper on "Aeroplane Engines," delivered by Mr. P. E. Biggar, featured the program of a recent meeting of the Montreal Branch of the Engineering Institute of Canada. This interesting topic was illustrated by several lantern slides showing the development of the aeroplane engine from the old 24-horsepower Wright Bros. model to the latest 1000-horsepower Napier type. The speaker served with the R.A.F. during the war.

## Personal

Mr. Ben. L. Whitney, formerly with the Byers Co., has opened an office at 528 Detroit Savings Bank Bldg., Detroit, Michigan, and will represent the Orton & Steinbrenner Co. in that territory.

Mr. Julian C. Smith, vice-president and general manager of the Shawinigan Water & Power Company, Shawinigan Falls, P.Q., has been retained to supervise the construction of the Manitoba Power Company's development. Mr. Smith was chief hydraulic engineer of the Cedars Rapids development, of the Montreal Light, Heat & Power Consolidated, near Cedars, P.Q., and is one of Canada's foremost hydraulic engineers. Mr. W. A. McLimont, vice-president and general manager of the Winnipeg Electric Railway Company, has been appointed general manager of the above mentioned new development.

## Obituary

Mr. John McIllwraith, prominent builder of Woodstock, Ont., died very suddenly in that city recently, at the age of 67 years. Deceased was born at Jarvis, Ont., but had been a resident of Woodstock for the past forty years, and was a member of the city council for two years.

# CONSTRUCTIONAL ACTIVITY

## Period of November 9 to November 15, 1921

***Dominion Wide Service Exclusive to "Contract Record & Engineering Review"***

### Waterworks, Sewerage and Roadways

**Gananoque, Ont.**
Town Council will construct pavement on Main St. James Procter & Redfern, Ltd., Engrs., Excelsior Life Bldg., Toronto.

**Hamilton, Ont.**
Construction of sewer at cost of $150,000 on Paradise Rd. from King St. for 2,000 ft. northerly is contemplated by City Council. E. R. Gray Engr.

**Montreal, Que.**
Construction of sewer at cost of $23,100 on Harvard Ave. from Monkland Ave. to St. Luke Rd., is contemplated by City Council.

**Ottawa, Ont.**
Suburban Road Cmsn., Thistle Bldg., are tarring about 5 miles of surface of roadway on Metcalfe Rd.

Construction of asphalt and wood block pavement on Nicholas St. from Rideau St. to Laurier Ave., is contemplated by City Council.

**Westmount, Que.**
Town Council contemplate opening new street between Clark and Mountain Aves. from Sherbrooke St.

#### CONTRACTS AWARDED

**Burnaby, B.C.**
Steel contract for waterworks extensions costing $29,795 for Municipality of Burnaby, is awarded to Paige-Heresy Co., Toronto, Ont.

**Hamilton, Ont.**
Scanlon & Moyer, 995 Barton St. E., have general contract for construction of sewer costing $10,000 on Longwood Rd., from end of present sewer to Paradise Rd. for City.

General contract for construction of sewer at cost of $5,000 Edgevale Ave., from Longwood Rd. to Paradise Rd. for City is awarded to Scanlon & Moyer, 995 Barton St. E.

### Railroads, Bridges and Wharves

**North Bay, Ont.**
Tenders will be called from Dec. 1st to Dec. 20th for construction of extension to railway costing $3,500,000 from Cochrane to Smoky Falls, 70 miles, for Temiskaming & Northern Ontario Rly. Cmsn., North Bay.

**Petrolea, Ont.**
Plans will be prepared for railway extension and siding to cost $25,000 for G.T. Rly.

**Sooke, B.C.**
Prov. Govt. will construct bridge over Sooke River. P. Phillip, Pub. Works Engr., Victoria.

**Drummondville, Que.**
Steel contract for metallic bridge costing $50,000 for Town is placed with Dominion Bridge Co., Ltd., Dominion Station, Lachine.

### Public Buildings, Churches and Schools

**Alberni, B.C.**
Erection of Community Hall costing $8,000 is contemplated by Community Hall Assn., Alberni.

**Blyth, Ont.**
Erection of addition to school is contemplated by Town Council. Alex. Elder, Clerk.

**Grande Prairie, Alta.**
R. C. Desrochers, secy. Dept. Pub. Works, Dom. Govt., Ottawa, will receive tenders until Nov. 25th for construction of a telegraph bldg. Plans and specifications can be seen and forms of tender obtained at Post Office, Peace River, Alta., Post Office, Grande Prairie, Alta., and office of Resident Architect, Dept. Pub. Works, Calgary, Alta. Tenders must be made out on forms supplied and must also be accompanied by accepted cheque for 10 per cent. made payable to Minister of Pub. Works.

**Hamilton, Ont.**
Scott & Wardell, architects, Merchants Bank Bldg., are preparing plans for altering church into school at cost of $49,000 for Separate School Board.

**London, Ont.**
John Iron, 531 Nelson St., Chrm. Bldg. Committee of Baptist Church Congrgation has plans and will receive tenders, no closing date set, for erection of church to cost $10,000.

**Ottawa, Ont.**
Erection of High School in Westboro is contemplated by High School Bd. Crawford Ross, secy.

#### CONTRACTS AWARDED

**Abbotsford, B.C.**
Nels Olund, Matsqui, B.C., is awarded general contract for erection of hospital costing $8,500 for Abbotsford Hospital Bd.

**Cap de la Madeleine, Que.**
Georges Guenard has brick and masonry contracts for fire station costing $20,000 for City.

**Hamilton, Ont.**
Additional contracts for altering church into school at cost of $49,000 for Separate School Bd., are: Masonry, Mitchell & Riddell, 46 Head St.; steel, Standard Steel Construction Co., 29 Cross St.; carpentry, R. A. Nicholson, 201 Homewood Ave.; roofing, Irwin & son, 22 McNab St.; elecplumbing and heating, Staunton & Mitchell, 173 York St.; plastering, Gleason & Grant, East End; painting, Jas. Church, Cannon St. E.

**La Tuque, Que.**
Ludger Venne, 85 Osborne St., has general contract for erection of Church and Presbytery for Parish.

**Montreal, Que.**
Wrecking contract for addition to warehouse and alterations to jail costing $250,000 for Prov. Govt., Dept. Pub. Works, is awarded to W. Lajeunesse & Cie, 688 Notre Dame St. E.

**Ottawa, Ont.**
Contract for reinforcing steel for Collegiate costing $700,000 for Ottawa Collegiate Bd., is placed with Dominion Reinforcing Co., Sparks Chambers, Sparks St.

**Parry Sound, Ont.**
Painting and glazing contracts for addition to court house costing $40,000 for Prov. Govt. Dept. Pub. Works, are awarded to Tucker & Wilson, Parry Sound. Contract for vault doors is placed with J. & J. Taylor Ltd., 145 Front St. E., Toronto.

**South Calgary, Alta.**
General contract for erection of church costing $13,000 for South Calgary United Church is awarded to Keddy & Taylor, 1734 32nd Ave.

**Vancouver, B.C.**
F. Franklin, 77 37th Ave. Vancouver, has general contract for erection of addition to church for 1st Free Presbyterian Church.

**Walkerville, Ont.**
Reinforced steel contract for High School costing $450,000 for School Bd. is awarded to Trussed Concrete Steel Co., Walker Rd., Walkerville, Ont.

### Business Buildings and Industrial Plants

**Acton, Ont.**
W. Mason contemplates erection of woolen mill.

**Arkona, Ont.**
Verne Huntley is erecting store and bakery at cost of $7,000.

**Berwyn, Alta.**
Gillespie Elevator Co., Edmonton, will erect elevator at cost of $12,000.

**Chatham, Ont.**
Plans will be prepared for ice cream plant to cost $100,000 for Silverwoods Ltd. A. E. Silverwood, Mgr., 517 Dufferin Ave.

**Fredericton, N.B.**
Wm. Thurott, Windsor Hall, contemplates erection of addition to hotel at cost of $20,000.

**Hamilton, Ont.**
Arthur O'Heir, Bank of Hamilton Bldg., will erect 2 stores and 4 apts. at cost of $30,000. J. A. Armes, architect, 67 Charles St. S.

**Montreal, Que.**
Warehouse costing $18,000 will be erected by Shinnick Ice & Cartage Co., 2668 St. Lawrence Blvd.

N. Beauchamps, 1559 Bordeaux St., plans erection of stores and residences.

Erection of ice house on Bossuet St. is planned by A. Senecal, 221 Prefontaine St.

**Toronto, Ont.**
Erection of factory is contemplated by International Wheel & Rim Co. Ltd. Jos. M. Crenan, Pres., room 802, Lumsden Bldg.

ESTABLISHED 1886

# Contract Record and Engineering Review

A National Journal for the Construction Interests of Canada, reaching Architects, Engineers, Contractors, Municipal Officials, etc.

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## *Toronto Rehabilitates Her Street Railway System*

Street railway track construction has never been carried out in Canada on quite such a wholesale scale as is being done in Toronto, Ont., at the present time. When the Toronto Transportation Commission took over the plant and equipment of the Toronto Railway Company, less than three months ago, it found itself heavily burdened with a badly dilapidated system that demanded immediate rehabilitation if an adequate and safe street car service was to be assured. The extent of the reconstruction that was required may be gauged by the fact that already the Commission has been appropriated $11,000,000. As a considerable portion of the necessary reconstruction must be held over till next year and will require further appropriations, it will be seen that the work of the Commission is one of the largest construction programs carried out in Canada in many years.

The problems which confronted the Toronto Transportation Commission, on assuming control of the city's railway facilities were stupendous, but one will agree, after reading the description of the activities on another page of this issue, that they have been efficiently handled. The Commission has indeed performed a record achievement in getting an organization together in such short order and great credit is due it for the manner in which the work has been carried out. The citizens can be assured that they are getting their money's worth, that every dollar spent is bringing a dollar's return in better streets, improved transportation service and greater business as a result of both. Of course, in connection with any contract, involving the expenditure of millions, there will be howls of wastefulness and extravagance, (especially just before municipal election date) but the Contract Record believes, after a thorough and intimate examination of the construction activities of this Commission, that these activities could be no more efficiently handled.

From a construction and engineering point of view, there are numerous features in the rehabilitation of Toronto's street railway system that are well deserving of attention. These are described in considerable detail in the article elsewhere in this issue. One point, however, is worth repeating and that is that the work is a splendid example of the application to track construction of highly developed contracting methods, with all the attributes of such methods—speed, efficiency, organization and a copious supply of rich ideas that mean more and better work for less money.

## *Ontario's Lieutenant-Governor's Tribute to Business Newspapers*

Ontario's Lieutenant-Governor, Col. Henry Cockshutt, himself an outstanding success as a business man, paid a fine tribute to the business newspapers of Canada when, speaking at a luncheon of members and delegates at the annual meeting of the Canadian National Newspapers and Periodicals Association at the King Edward Hotel, Toronto, on Thursday, November 10, he said:

"I am especially glad to be with you to-day, because I believe that the influence of the business press will be one of the most important factors in re-establishing business conditions in Canada on a safe and sane basis. I make a distinction between the business newspapers and the daily press because of the greater confidence your readers have in them. People read the daily newspapers to keep abreast of the general news of the day. They are interested in what is happening around them and they read to satisfy their desire for excitement or interest or entertainment. What they read in the daily newspapers to-day is forgotten to-morrow.

"But this is not the case with the business newspaper. Business men need the service of these papers in the conduct of their every-day business life. I have noted that they usually have a business paper or two in their pocket when they go home Saturday night. I do not say that they read them on Sunday; that I do not know, but I do know that they study them carefully, and that a great number of your readers will come to their business on Monday morning with some clippings from your paper in their pockets. They will say to their associates: 'This is the situation; I can show it to you in this clipping.' For that reason, gentlemen, I say that yours is the greater obligation, because you are leaders; because you are helping to build up the business fabric of the country.

"You should be very careful that everything that appears in your columns bears the imprint of the truth. You must be sure that the news you give is correct beyond question, because there are thousands of your readers ready to set their businss course by the information and advice you give them.

"I am familiar with a good many of your publications, and I can personally attest to their high character. It is of vital importance that this high character should be maintained and that no effort should

### *No. 70*

## *Canada's Engineers – Romeo Morrissette*

**Romeo Morrissette, who is a well known consulting engineer of Three Rivers, P. Q., was born in that city in 1887. His engineering education was received at Ecole Polytechnique Montreal, in which institution he was enrolled from 1907 to 1909, and at the International Correspondence Schools. He was examined as regards his engineering ability by the Board of Examiners of the Engineering Institute of Canada and was forthwith appointed assistant in the Department of Public Works of Canada, in which capacity he directed the dredging work in the Batiscan, Yamachiche, du Loup, Yamaska, St. Maurice, Maskinonge and St. Francis Rivers. In 1911 he was appointed assistant to the engineer in charge of the construction of the new coal dock at Three Rivers, and a year later became principal assistant engineer to F. X. Thos. Berlingeut, district engineer of the Department of Public Works at Three Rivers and later to the late Honore B. Tourigny superintendent of the St. Maurice river works.**

**Among the principal works carried on in this district were the improvement in the logging facilities of the St. Maurice River, to meet the vastly increased log drives from that vicinity. Mr. Morrissette also designed and supervised the construction of the wharf at Cap de la Madeleine, constructed landing piers at Batiscan, Louisville, etc., and made studies and reports on the construction of dams at La Loutre and Grand'Mere. The question of the backwater problem above the proposed dam at La Forges Rapids, St. Maurice River, was reported on by Mr. Morrissette, who also promoted the idea of contracting the St. Maurice River outlet so as to avoid large annual expenditures in dredging.**

**In 1920 he became connected with the Three Rivers Shipyard Company and in August of the same year entered private practice in Three rivers. During part of the time he acted as engineer for the town of Cap de la Madeline and since April of this year has devoted all his time to that town, being in charge of the street lighting, roads, water and sewers systems.**

Mr. Romeo Morrissette

**Mr. Morrissette is a member of the Corporation of Professional Engineers of Quebec and an associate member of the Engineering Institute of Canada and a member of the American Association of Engineers.**

be spared to give in your columns the maximum of service.

"In these days when there is disorganization, dissension, disruption in all walks—business, politics and religion—there is a great place for the business paper to bring out more complete information, to assist in making us all realize we must work for a common cause—the upbuilding of our country.

"The business men of this country need your assistance. They are looking to you for information and advice, and are expecting it. On your shoulders, therefore, perhaps more than on the shoulders of any other single agency, rests the obligation to meet the needs of these trying days, and make a sane and sound presentation of the case as it exists at the present time, a presentation free from private bias, or the desire to serve a popular demand.

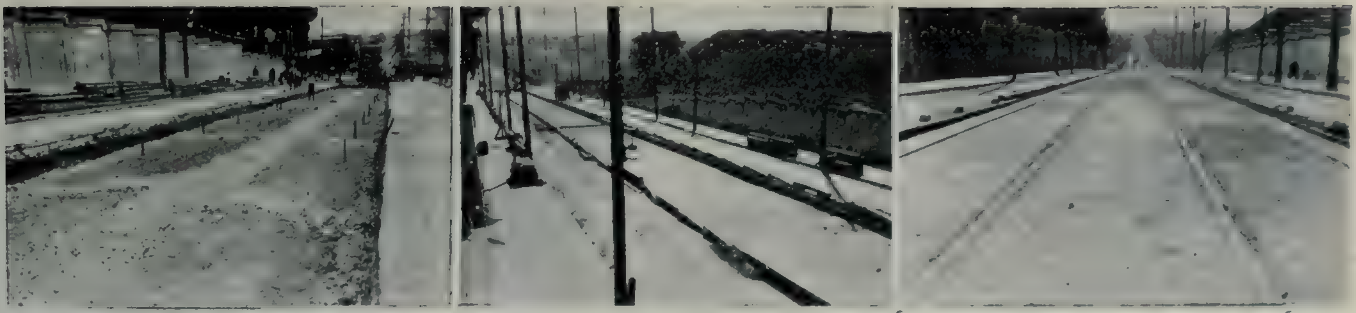
"You can, and I believe will, be one of the largest factors in helping to bring about a satisfactory readjustment of the business conditions of this country."

## *Montreal Building Situation Improves*

The Montreal building season, now practically finished, has been better than was generally expected at the commencement of the period. Up to the present, permits of a total value of $17,500,000 have been issued for the city, besides which we have to reckon the permits for the surrounding municipalities. The first three months showed only a moderate amount of construction, but from then on the work appreciably increased, until for the first two weeks in November the permits were valued at $5,500,000, this large sum being due to the inclusion of the $5,000,000 permit for the Mount Royal Hotel.

Some of the buildings involve large expenditures. For instance, there is the new 10-story structure of the Canada Cement Company, now in the course of erection. Two additions to McGill University will cost over half a million, while a school will cost the same amount. A new hospital is expected to run into $500,000 and two or three new churches will also cost large sums. Although there are many apartments to let, other large apartment houses are being constructed.

A feature of the building program was the number of dwelling houses constructed and in course of construction. The total by no means meets the requirements of the people, but it is significant that investors are once more turning to this form of laying out their capital. In this connection Montreal has had a rush of building societies, formed to assist working people to buy their homes on the instalment plan. Some societies will sell houses already built, others will advance money to owners of lots, or will undertake to build houses. The repayments over long periods take effect in the form of rent. The governing principles of such schemes are to be commended, in that they enable people to become property owners by easy paymens—people who otherwise would not be in a position to become proprietors of their houses.



These illustrations show three stages in the track laying operations on Bathurst Street hill, Toronto and indicate the rapidity with which the work is carried out. In this instance the line is entirely new and the same speed was not called for as on rehabilitation work, where traffic is waiting to make use of the rebuilt lines. However, only a month was necessary for the track laying from the time of breaking pavement to the completion of the road, ready for traffic. The illustration on the left shows the road bed as it appeared on September 16, while three days later, as shown in the centre picture, the foundation course of concrete had been poured. Ties, rails and granite block pavement were then laid, the finished appearance of the line being shown in the right hand illustration, which was taken on October 13.

# Reconstruction of Toronto Street Railway System on Large Scale

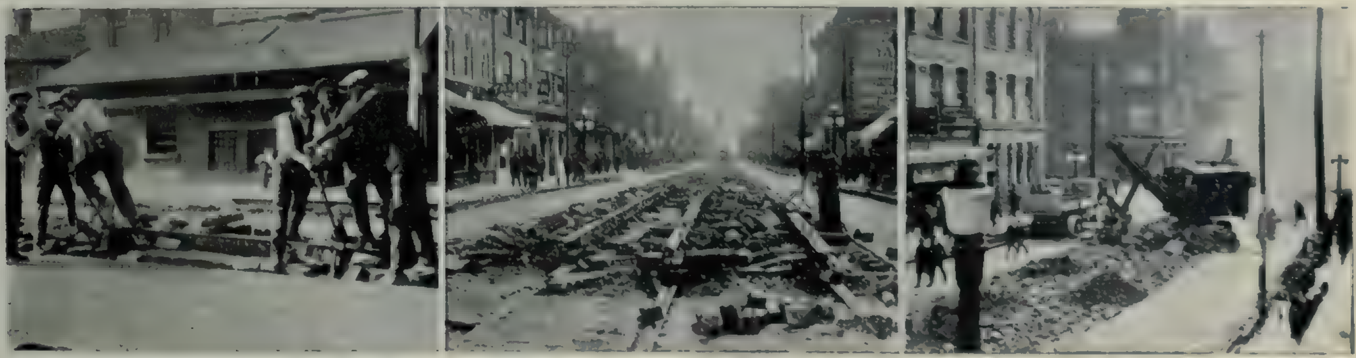
## Track Rehabilitation Carried Out by Methods Designed Primarily for Speed—Construction is of the Most Substantial Character—Among the Many Interesting Features of the Work are Steam Shovel Grading, Rapid Pavement Breaking and Batch-Transfer Method of Concreting

At midnight on August 31, 1921, the 30-year franchise of the Toronto Railway Company expired, and the system was automatically taken over by the Toronto Transportation Commission, which, for several months prior to that date, had been gathering an organization to handle the new responsibilities. In addition to the system of the railway company, the five branch lines owned by the city and operated by the Commissioner of Works, and aggregating 20½ miles of single track, were also handed over to the Commission, so that the control of the entire street railway facilities of the city, excepting the radials and certain sections of line controlled by the Toronto Suburban Railway Co., are now centred in the one administration. By an agreement of sale between the private owners of the suburban lines, the Hydro-electric Power Commission of Ontario and the city of Toronto, the ownership of all these lines within the city limits will ultimately pass to the city, and their operation will also be vested in the Commission, resulting in a unified system of over 163 miles (single track).

The Toronto Transportation Commission is composed of Messrs. P. W. Ellis, George Wright and Fred Miller, and by provincial legislation is given entire control of the transportation facilities of the city, being required to operate them on a basis that will meet all fixed and operating charges, with fares regulated from time to time to suit this policy.

### A Big Program of Reconstruction

The greatest of the many difficult problems confronting the commission, on taking over the street railway lines on September 1, was the matter of rehabilitation of the tracks and equipment of the Toronto Railway Company, which, for the most part, had become run down and dilapidated to such an extent as to be prejudicial to good service and, in many cases, absolutely dangerous to traffic. On many important lines tracks had become hopelessly deteriorated, rails were split, slivered or broken, and the entire construction was inadequate for heavy cars and rapid service. In addition, the devil strips on various sections were too narrow to ensure the use of the wide



When a street car line is to be rehabilitated, the old rails are jacked up as shown in the left hand illustration and are then cut by means of an oxy-acetylene flame into lengths convenient for hauling to the storage yard. The granite setts or paving brick are salvaged, if of value, after which the grading of the road bed is carried out by means of a steam shovel, the spoil being carried away on motor trucks.

cars used in modern street car service. Intersections, as a rule, were also bad, having narrow devil strips and curves that did not permit the cars to pass.

The transport facilities themselves were also entirely inadequate for a city the size of Toronto. Many of the old cars had to be remodelled to make them fit for further service. In addition, some 250 fine, new coaches have been purchased and are being operated as quickly as the rehabilitation work will allow.

The increased rolling stock brought in its wake the necessity for greater car barn accommodation. This work is also being rushed concurrently. Accommodation has also been built for the motor buses, a number of which are being tried out.

There was thus a vast program of reconstruction work to be undertaken in order to rehabilitate the system sufficiently to ensure adequate transportation service. In addition there were required a number of new lines to link up existing routes or provide street car facilities for districts that had never been served. To take care of this renewal and rehabilitation work, which to date has involved the expenditure of approximately seven million dollars, the Commission had to build up a strong construction organization under competent engineers and superintendents, collect and train a huge labor force and purchase a vast amount of construction equipment designed to facilitate and speed up the track laying and building operations.

Pneumatic tools are made extensive use of by the Toronto Transportation Commission's construction forces. Pneumatic drills break up old concrete and pavement, while pneumatic tamping tools are employed to bring up the new tracks to grade.

### Speed the Essential Element

Except on the civic owned lines—which were in good shape and required no repair work—the Transportation Commission was not permitted, of course, to start any work until the system was legally handed over to its jurisdiction on September 1. However, plans were made for an immediate start upon the expiration of the franchise, and within a few days rehabilitation was commenced at various points throughout the city. As the remainder of the construction season was short—it not being considered safe to carry out much work after November 15, on account of the possibility of frost—speed was the essential element in the operations and, therefore, an organization was built up to carry out as much rehabilitation as could possibly be done in the two and a half months available. This involved the employment of a labor force of nearly 3,000 men.

As an initial procedure, it was considered absolutely essential to reconstruct certain main lines to make them safe for the general public. Where the track was in reasonably good condition, only repair work was undertaken for the present until such time as the whole route is reconstructed.

At many points throughout the system it was necessary to install new intersections. These have been entirely redesigned and the parts standardized.

The chief part of the rehabilitation, however, has been the rebuilding of lines in their entirety from road bed up, the old rails, ties and foundations being completely scrapped. In some cases this work has been done under traffic, in which case progress has been necessarily retarded by the interference of street cars with operations and the inability to use mechanical plant to speed up the work and keep it continuous. On those streets where traffic could be diverted, however, rapidity of operations was the main consideration, and by the aid of machinery and special labor saving ideas, tracks were rehabilitated at a speed and with an efficiency that, it is generally said, has never been excelled in connection with this type of construction. To satisfactorily follow out this program, the construction department was organized along the lines that were demonstrated to be so satisfactory during war years in building camps and erecting factories with the utmost speed. As every day's delay in opening streets for traffic badly congested the streets, overloaded those routes that carried detoured cars, and interfered with the trade and business of firms on closed thoroughfares, it was imperative that routes be reopened at the earliest possible moment. The shortness of the season, too, added an incentive to speed up the work so that as great a mileage as possible might be reconstructed before frost made it necessary to close work and disband the organization.

### Heavy Construction Used Throughout

Permanency and solidarity has been the aim of the Transportation Commission in its efforts, and with that object in view, the rails and track base are of a most substantial type, designed to have long life under the heaviest traffic that is likely to become general in street railway service. Rails are thus 122-lb. grooved girder sections throughout, and are carried on oak or jack pine ties borne on a 9-inch concrete slab, the coarse aggregate of which is a trap rock of extreme toughness. Embedding the ties and base of rails, is another concrete slab made with softer aggregate and separated from the base slab by a layer of fine stone and dust, which, when spread, is carefully tamped to bring the rails and ties to true grade. This means resilience. Another advantage in separating the two slabs is

An improvised steam hammer working in leads suspended from a steam shovel boom was used by the Toronto Transportation Commission as a pavement breaker. By this means the road surfacing or concrete base was broken, enabling the steam shovel to immediately follow up with the excavation.

to facilitate removal of rails, should that be desirable at any time, without interfering with or destroying in any way the track foundation, which is regarded as permanent. The use of trap rock in the base adds to its toughness and permanency, while limestone in the top lift ensures easier removal of that slab if necessary. Furthermore, the rails are welded together for mechanical security and to give a better electrical return circuit.

This design, described above in general terms, is standard on the reconstruction work in Toronto. All intersections, however, and on certain sections of track where the bearing surface of the sub-soil is suitable, crushed stone is being used as a base material in substitution for the concrete slab. In several cities foundations of that type have proven satisfactory.

### Special Methods Speed Up the Work

In the rehabilitation work, many practical ideas were adopted which contributed to speed and efficiency. Thus excavation of road bed was performed at a very rapid rate by steam shovel, while in concreting. a batch-transfer scheme was used, the dry mix being conveyed in specially designed batch boxes from a central source of supplies to the mixer. Old rails were jacked out of their bedding and cut with oxy-acetylene flames. At the supply yards, mechanical loaders with measuring hoppers facilitated the handling of stone and sand. These and other features of the work will be described in full detail as this story progresses.

Where traffic cannot be removed entirely from a street, rehabilitation operations are facilitated by the laying of a temporary track on the roadway. This illustration shows such a temporary track on a portion of Yonge Street. By this means, the renewal of the rails on both tracks may be carried out at one time without interference from traffic In this instance, only north bound traffic is carried on the temporary track, south bound traffic being diverted to a neighboring parallel car line. In some cases it has been necessary to carry one line of traffic on the old track, in which case only one track can be renewed at a time.

When a track is selected for rehabilitation, traffic is absolutely diverted if it is possible to re-route the street cars along neighboring parallel car lines. The street is thus left free for the unobstructed progress of the reconstruction work. The one mile of double track on Yonge St. (Toronto's main thoroughfare), from Front St. to Carlton St., and a half-mile of double track on Front St., from Yonge St. to George St., were reconstructed in this way, without any interference from traffic whatever. Another section of Yonge St., from Carlton to Bloor St., was also rehabilitated in the same manner, although in this case it was found possible to divert street car traffic in only one direction, the remaining traffic being carried, however, on a temporary track laid on the pavement. Vehicular traffic was, of course, entirely diverted. In some cases, for example Yonge St. from Bloor St. north for a mile, it was not possible to reroute street car traffic owing to the non-existence of parallel lines, and in such instances, one track was reconstructed at a time, the traffic normally using that track being carried on a temporary track on the pavement at the side of the street. When the first track was entirely rebuilt, the traffic was switched from the other track while it was undergoing rehabilitation. Reconstruction under traffic has been confined, with but a few exceptions, to intersections where, of course, the number of routes using them forbade diversion of all the traffic over the crossing.

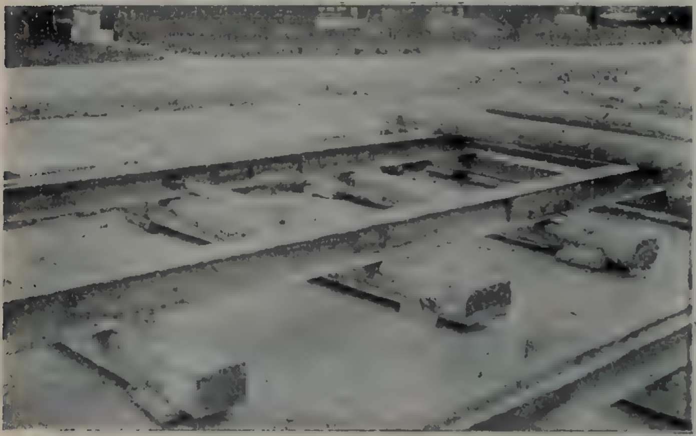
### Excavation by Steam Shovel

In commencing reconstruction operation the old rails are jacked up without any prior removal of the paving. As a rule, the jacking lifts the rails quite free from the ties and from the paving brick or granite setts forming the pavement in the track allowance. The rails were then cut in convenient lengths by oxy-acetylene flames and hauled to storage yards to be later disposed of as junk. The paving brick and granite setts are collected and, in the case of the latter, re-dressed and re-used. The road bed is then excavated by means of a steam shovel, of which the commission has three, of the Marion three-quarter-yard type, one of which is mounted on caterpillar treads and the others on wheels. Where single track only is being reconstructed, the shovels mounted on wheels must be employed, as the caterpillar tread outfit is too wide for the cut. Prior to removal by the shovel, the old concrete foundation is broken up by air tools or jackhammers, the air being supplied by either an oil-driven compressor of the portable type or by a compressor car, operating on the street car tracks. The spoil is loaded by the steam shovel directly on the trucks and carried to convenient dumps. By doing the grading in a wholesale manner with the steam shovel, very rapid progress is assured and over 400 ft. a day, double track, is a general rule.

The concrete materials are mixed in their proper proportion at a central yard and hauled in bottom dumping batch boxes to the mixer. This ensures accuracy of mix, saves time, dispenses with a large laboring force and keeps the street clear of stone and sand piles. Each batch box contains 33 cu. ft. of material, making 21 cu. ft. of mixed concrete.

The air tools mentioned above were used in proximity to sewers. Otherwise the pavement breaker, described elsewhere, was more rapid and effective.

The concreting of the base slab follows immediately upon the excavation, the sub-soil being first drained with a line of tile pipe, imbedded in gravel, along the centre line of the track allowance. The mixers are of the Foote type, producing a 21 cu. ft. batch. They are on caterpillar treads. The dry materials are pre-mixed at a central yard and conveyed in batch boxes to the mixer. Each batch box contains 33 cu. ft. of loose material, which is dumped into the loading skip of the mixer through bottom opening gates which are opened after the box is spotted over the skip by means of a derrick on the mixer body. Two batch boxes are carried on a truck and the trucks are so timed that no delay is occasioned through failure of supplies. Concreting operations are, therefore, continuous and, very rapid progress is made, so much so that it has been found necessary to keep the steam shovel very much in advance of the mixer. The foundation slab is of 1:2½:5 mix, trap rock running from 2-in. to ½-in. in size, as the coarse aggregate. Nine inches is the standard depth of slab. When this foundation has taken its set, ties and rails are laid and roughly aligned. Oak ties have been used wherever possible, but owing to their scarcity, softer ties have had to be used on some of the more unimportant streets. With soft ties, the rails are spiked through tie plates which are deemed unnecessary where oak ties are employed. On top of the foundation, a mixture of 60 per cent. ⅜-in. stone and 40 per cent. dust is laid and tamped under and around the ties to bring the tracks up to proper grade, and to give resilience to the track, thus greatly improving running qualities. The second course of concrete is then laid thoroughly embedding the ties and base of rails. This course is of 1:3:6 mix with a screened gravel as the coarse aggregate. The track is then ready for the pavement, which is mainly granite block laid in standard fashion on a sand base with cement grouting.

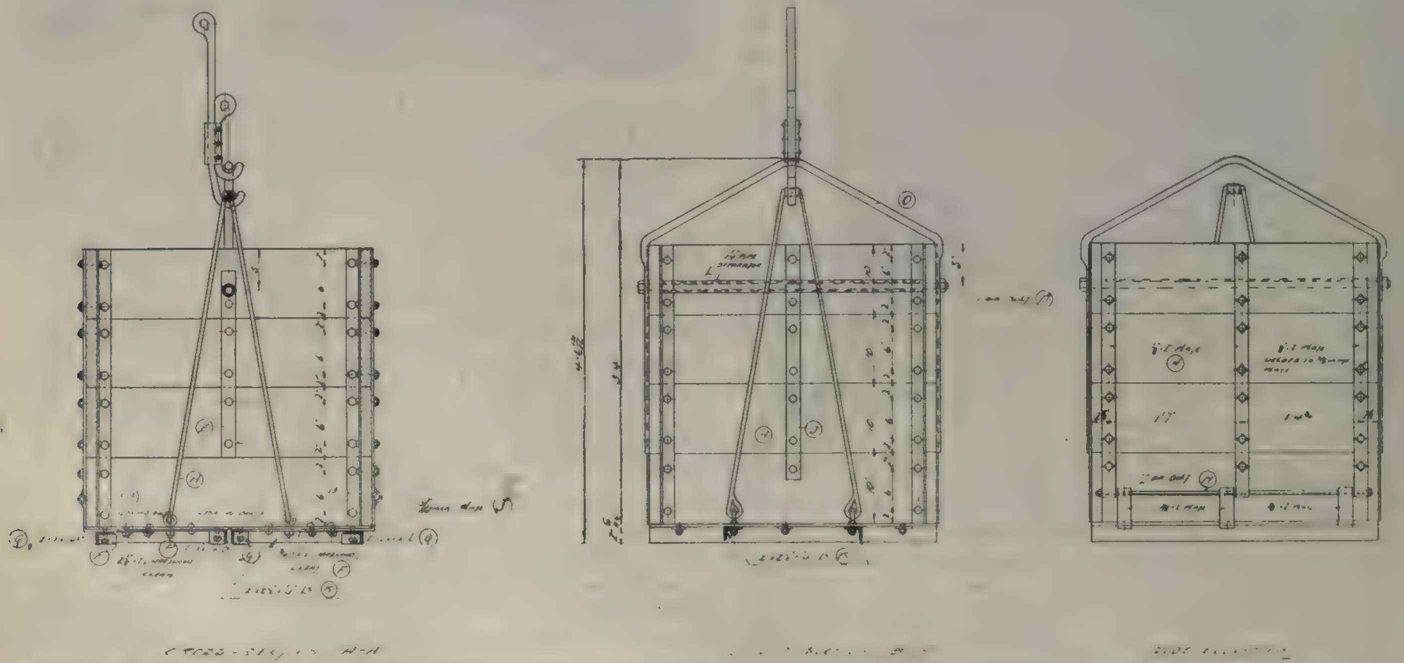


In some cases, where traffic conditions made it impossible to wait until the concrete foundation had properly set before opening the street, the rails and ties were carried on blocks resting on the sub-grade. This enabled the street cars to proceed without interfering with the hardening of the concrete foundation. The blocks are kept well outside of the line of the rails, so that there will be solid concrete beneath the points of load.

### Practice in Special Cases

This general procedure has, naturally, been altered in certain details in order to suit the particular requirements of the street on which work is proceeding. For example, on a certain portion of Bathurst St., it was found impossible to divert traffic for any time longer than necessary to pour the foundation. The new tracks were, therefore, laid and carried on blocks resting on the sub-grade, only every alternate tie being used. The concrete foundation slab was then poured while traffic was using the tracks. As the load was carried to the sub-grade through the blocks, there was no interference with the setting of the concrete. When the concrete had sufficient time to set, the wedge blocks between the ties and the supporting timbers were removed, allowing the ties and rails to rest on the concrete. The alternate ties were then inserted and the track con-

A great deal of intersection work has been carried out, on of which, at Queen and Victoria Streets, is shown in this illustration. Rehabilitation work of this character has been carried out under traffic. All new intersections have been entirely re-designed and the parts standardized. A Wettlaufer mixer is used for concreting.



Details of the batch box used by the Toronto Transportation Commission for carrying batches of pre-mixed dry concrete ingredients to the mixers at the site of the work.

struction completed in accordance with the method detailed above.

### Rails Welded Together

In order to secure a continuous electric return circuit, adjoining rails are electrically welded prior to the pouring of the second lift of concrete. An arc welder is used for this purpose, welding the plates to the rails at top and bottom for their full length. In addition to giving proper electrical contact, this method adds to the rigidness of the construction and dispenses with all but two bolts through the plates.

### Pavement Breaker

Where tracks are laid on streets that have hitherto carried no street car traffic, the same procedure is followed, except that the pavement is broken up by means of a large pavement breaker of unique design. This is virtually a steam pile driver carried on leads suspended from the boom of a steam shovel. At first a drop hammer arrangement was employed. By means of these devices very rapid progress was made in the breaking up of pavement prior to excavation and track laying operations.

The steam pavement breaker was also utilized for breaking up the old concrete foundation slabs (after the rails and surfacing had been removed) unless the sewers were so close to the surface as to be endangered by the constant shocks.

On the Teraulay St. extension, Toronto's new 86-ft. thoroughfare, parallel to Yonge St., the construction is interesting in view of the fact that the street is not yet cleared or graded. In view of the need for some relief to the congestion on Yonge St., the tracks have been laid before any work has been done on the roadway. While the construction is essentially the same as that described previously, added foundation strength was secured by the use of some heavy slabs removed from a section of the Yonge St. work. On the latter street, in the section between Carlton and Bloor Streets, some very excellent concrete was discovered, this breaking up into large slabs capable of use on the Teraulay Street work.

Concrete materials are pre-mixed at a central yard and distributed in batch boxes by means of motor trucks. The boxes are loaded at yard by means of bucket loaders, which accurately proportion the amount of material necessary for each batch. This illustration shows three such loaders, one for sand and two for stone, in process of filling a truck load of two batch boxes.

Intersection rehabilitation is in general carried on under traffic, as it was impossible to divert all the traffic using these corners without causing tremendous congestion or delay. Work was carried on 24 hours a day, but the greatest progress was made after midnight, when the car service was more limited. Pneumatic tools were very widely used to break up the old pavement and concrete, while the excavation had necessarily to be done entirely by hand. The new tracks and ties were laid on crushed stone, as already explained.

New rails are thoroughly bonded by being welded together solidly. The illustration shows the welding operation in progress, the plate being bonded to the rail along its full length at both top and bottom.

### Pre-mixed Concrete Ingredients

A reference has been made to the use of the batch transfer method of handling concrete material in all of the Toronto Transportation Commission's work. By this system properly proportioned batches of dry ingredients were hauled on motor trucks to the mixer. The advantages are very obvious. A large labor force at the mixer is dispensed with; the streets are kept entirely clear of materials, and batches are in readiness as often as the mixer can handle them; at the yards, where the ingredients are proportioned, a large labor force is unnecessary, as the materials are handled almost entirely by mechanical equipment. The commission has two yards where work of this character is carried out, namely, at Coxwell Ave., in the east end of the city, and at Bathurst St., in the central north part of the city. In addition there is also a large storage yard on Merton St., where rails, ties and other track supplies also come in direct by train. At the Bathurst St. or Hillcrest Yard, which has been selected as typical, there are two heavy locomotive cranes continually unloading stone and sand to the extent of 1,500 to 2,500 tons a day, which figures also represent the amount of material going out of the yards. The various materials are arranged in stock piles from which the trucks obtain their quota by means of a large fleet of Barber-Greene loading machines. These machines are of the bucket type, which lift the materials into a measuring hopper or chute, according to whether a measured quantity is desired or not. They are mounted on caterpillar treads and are entirely self-contained, so that they may be readily shifted from one part of the yard to another. The various piles of materials are as follows: 1st, crusher run (for special foundation work); 2nd, tamping material (60 per cent. ⅜-in. stone and 40 per cent. dust); 3rd, sand; 4th, screened gravel (for top lift of concrete); 5th, trap rock (for foundation slab). Each truck leaving the yard for a job carries two batch boxes, each containing 33 cu. ft. of loose material. They are filled first with the proper amount of sand and then receive the correct proportion of gravel or trap rock, as the case may be. The proper number of bags of cement are then placed on top, these being opened and dumped en route by a man travelling with the truck. In this way much time is saved and any congestion at the cement platform is avoided. The cement platform is at such a height that very little lifting of the bags is necessary in loading up the trucks. When the job is in progress, there is a continuous stream of trucks coming to the yards, loading up and leaving for the site of the work. In this way a supply of materials is made constantly available and the continuous progress of the work is not held up.

• • •

The supply of machinery and materials on such a large scale necessarily involved business connections with a large number of firms. Other things being equal, the Made-in-Canada principle was strictly adhered to, though we think it is to the credit of the commission that there is no evidence of discrimination in favor of purely local firms. The following list, while far from complete, indicates the organizations that had a more important part in supplying material for this great work: Canada Wire & Cable Company; Davis & Bournouvilue; Harvard Turnbull & Company; Railway & Power Engineering Corporation; J. T. Hepburn; Mussens, Limited; Canadian Ingersoll Rand Company; W. M. Graham; Wilcox Brothers; Wettlaufer Bros.; Lincoln Electric Company; Brown Hoist Machinery Company; Ohio Brass Company; A. R. Williams Mach. Company; Chicago Pneumatic Tool Company; F. H. Hopkins; Holden Company; National Steel Car Corporation; Steel Company of Canada; Dominion Bridge Company; Northern Electric Company; Drummond McColl Company; Standard Underground Cable Company; Eugene F. Phillips Electric Company; John E. Russell Company; Rogers Supply Company; Frank Ryan & Company; Toronto Sewer Pipe Company; Ontario Lime Company; J. Muldoon; S. McCord; Brantford Sand & Gravel Company; Sand & Supplies, Limited; Ontario Stone Company; Point Anne Quarries; J. Maloney; Britnell Construction Company; Kilmer & Barber; Crushed Stone, Limited; Ontario Rock Company; Levy & Westwood.

Cartage trucks for moving debris and transporting material from the storage yards to the jobs were furnished, in the main, by construction and cartage companies. The need for speeding up the work was so great that particularly every truck available in the city was brought into requisition. The major number, however, were supplied by the following: Dufferin Construction Company; Lumsden Engineering and Transport Company; Hardy Cartage Company; Marsh & Morrison; Castellani Construction Company, and Angstrom & Verochio.

# Tidal Research Work in Eastern Canada

Have you ever had occasion to refer to tide tables? Did it ever occur to you how this advance information is compiled?

The general public are unacquainted with the method of obtaining information concerning tides. The system of reducing the tidal observations is complicated and technical. The usefulness of the survey can, therefore, best be judged from the published results as shown in the annual tide tables issued by the Naval Department. These tide tables give the time of the rise and fall of the tide or the turn of the currents along the Canadian coasts for periods of one year in advance; that is, the time of the tides for 1922 may be obtained from the tide tables issued in the fall of 1921. The tide tables also give for various regions the height of the tide and the depth over certain areas at high and low water. The information is valuable to shipping interests as they are enabled to know the depth of water over bars and shoals at the entrance of our harbors at any stated period. The information compiled by this survey is also useful with regard to mean sea level which is determined by them and which is used by land surveys as the basis of their levelling operations.

The record of tides is obtained by use of an ingenious instrument actuated by clockwork. This instrument gives a continuous curve which shows the height of the tide at every moment throughout the day and night, and thus records more accurate information than could be obtained by three men set to observe the tide in eight-hour shifts during the 24 hours of each day. These instruments, to give correct results, must be carefully installed and must also be kept accurately set.

The tidal records compiled by the Canadian Government have now reached a high standard of perfection and Canada is well in the lead in recognizing the importance of tidal information not only for navigation purposes but also as a basis for carrying out levelling operations and survey work on land.

Extensive tidal research work has been carried on by the Tidal Survey Branch of the Naval Department during the past summer. This work was performed in order to abtain additionall tidal data over that compiled in previous years for our harbors and various other areas for which tidal information is required.

During the past year observations of the tide were made at Campbellton and Dalhousie at the head of Chaleur Bay and other harbors in eastern New Brunswick, where the tide is of special importance because of bars at their entrances. At these harbors, considerable dredging has been done, or is in prospect. Tidal data are essential in relation to low-water levels and the amount of rise of tide where the depth of water available for navigation is limited. The tidal data will facilitate the determination of what amount of dredging is necessary.

Three new tidal stations were put in operation at the entrance to the St. Lawrence, viz., at Gaspe, Fox River and Seven Islands. Tidal data were also obtained for the east coast of Hudson Bay and for James Bay. In addition to the special work undertaken, the six permanent tide stations on the East Coast have been continued and from the reduction of the records obtained will be compiled tide tables for future years.

# Canada Takes Lead in Concrete Testing

## Through the Laboratories of the Hydro-Electric Power Commission of Ontario, Important Researches Are Being Made that Result in Highest Quality Concrete on Power Jobs.

By R. B. YOUNG, Assistant Laboratory Engineer, Hydro-Electric Power Commission of Ontario, in H.E.P.C. Bulletin.

The Hydro-electric Power Commission of Ontario is at the present time one of the biggest manufacturers of concrete on the continent. Before the completion of the Queenston-Chippawa power development over half a million cubic yards of concrete will have been placed by the commission in various structures. This means an expenditure for materials alone of over $3,500,000, and a cost for the labor and plant necessary to convert these materials into concrete of as much more. Obviously the commission is interested in any means of cheapening a product of which it is such a large user and would be justified in undertaking any legitimate steps to this end.

Concrete is not a material of uniform quality. There is good concrete and poor concrete, and unfortunately the latter is not uncommon. Many concrete structures built but a few years ago are to-day showing unmistakable signs of disintegration. In order to safeguard its investment the commission must demand that its structure be permanent and it is therefore vitally interested in the quality of the concrete of which they are constructed. Any methods which will ensure high standards of quality would likewise be important.

For these reasons the commission some years ago began to study and develop the methods for inspecting and testing concrete and concrete materials and for their proportioning, mixing and placing in the field. The methods which it has adopted for all its work are the result of these studies. They are thought to be in advance of those of any other large concern in Canada if not in the world. These methods enable the engineers of the commission to guarantee the quality of the concrete and in most instances to cheapen its cost.

### Wide Variety of Researches

The fundamental researches on which these methods are based have been carried out by the laboratories. They have consisted of studies of methods of testing cement, sand and stone both for quality and for their concrete making properties; of determining the proportions of these ingredients to obtain concretes of the desired strengths: of the effect of gradation, silt and impurities on the strength of concrete, of the laws governing the plasticity of concrete mixtures and of field methods of measuring, mixing, placing and inspection of concrete.

Concrete differs from nearly all other structural materials for it is manufactured upon the site of the structure of which it is to form a part. For comparison take its greatest rival, steel. The steel for a steel structure is manufactured in a highly organized steel mill under rigid control—it is fabricated in a well-equipped structural shop and on the job it is only assembled into place. In concrete the only manufactured material used is the cement—the rest of the ingredients are raw materials obtained locally and the whole is combined on the job to form concrete. Because of this it is not usually appreciated that the production of concrete is a manufacturing operation and should be handled as such.

It has been found in manufacturing that a uniformly high quality product can only be obtained with proper materials processed under the immediate supervision of experts. The same principle holds for concrete and

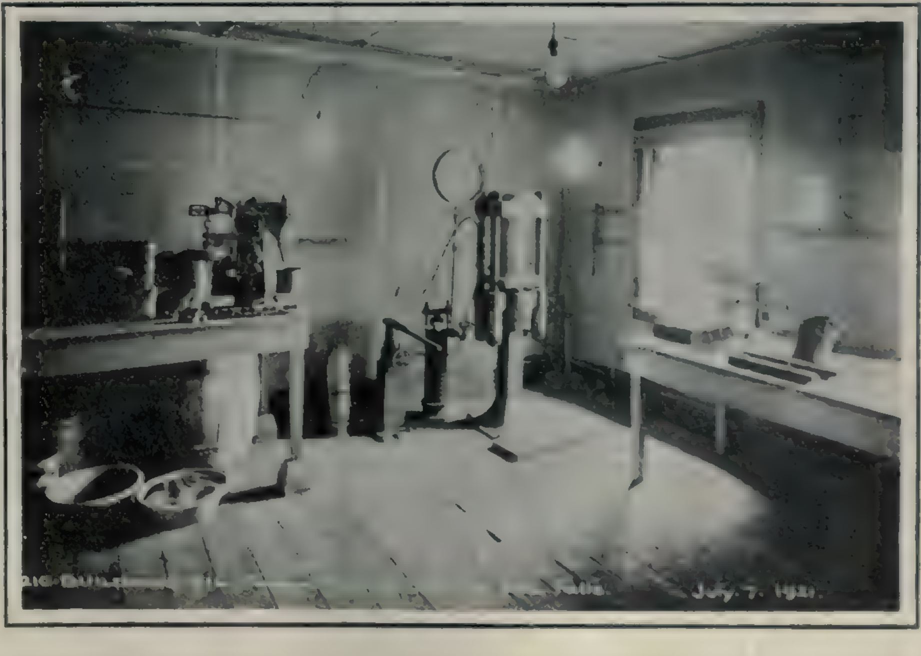


Fig. 1—A typical field laboratory, Queenston-Chippawa power development.

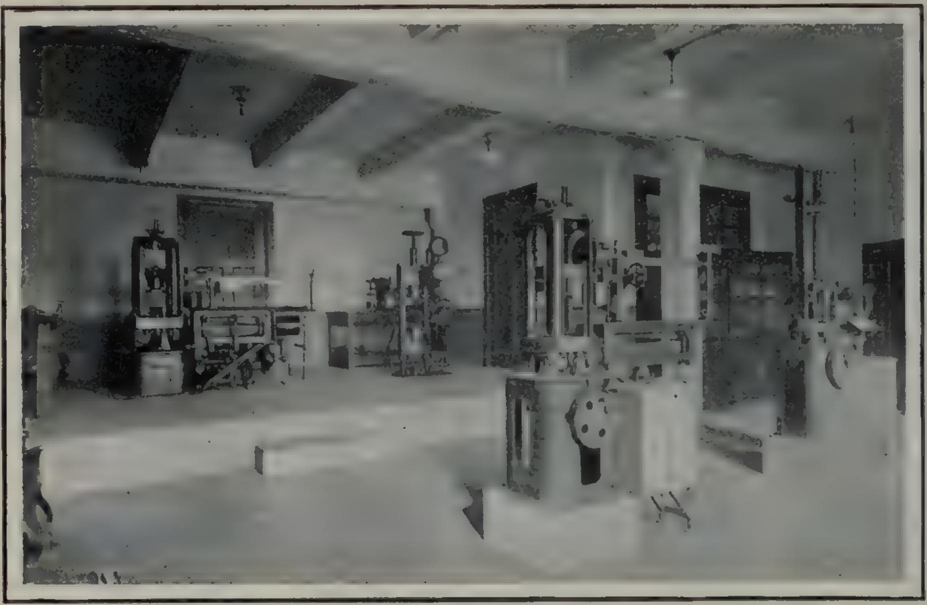


Fig. 2—Machines used in testing structural materials, the Hydro laboratories, Toronto.

for this reason the commission maintains a system of rigid inspection of all materials and processes in its manufacture. The consequence of this has been that on High Falls, Nipigon and Queenston-Chippawa power developments the concrete has been of an unusually high and uniform quality and the results have fully justified the precautions taken.

The methods developed for the inspection and testing of cement consist in brief of mill supervision and sampling to enable the necessary tests to be carried out prior to the arrival of the cement on the job where it is to be used and of laboratory tests to determine its quality.

In testing sand and stone the same principle is followed. After preliminary studies have been made to determine the suitability of the material and its concrete making properties, periodic tests of the material as supplied are made to determine its gradation, cleanliness and the proportions of cement which must be used to attain desired results. Beside this, the sources of these materials are kept continually under observation.

### Proportioning Methods

The proportions of cement, sand, stone and water which under any given conditions will give concrete of the desired quality are determined by a method of proportioning known popularly as the surface area method but which as used by the commission, is some-

Fig. 3—(a) Example of high quality concrete. Draft tubes of the Nipigon power development.

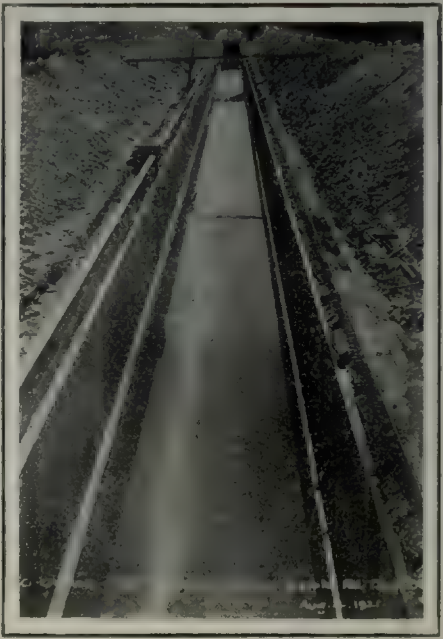


Fig. 3—(b) Example of high quality concrete. (Canal lining, Queenston-Chippawa power development)

what different from the method properly called by that name. This modified surface area method was developed in the laboratories of the commission as a result of its experimental investigations and researches. The method is simple and practicable and offers an effective way of setting proportions. A description of it is given in a future article.

The inspection of concreting operations includes all details in connection with proportioning, mixing and placing. An effort is made to see that all materials are accurately measured, that the batches are properly mixed and that the methods of placing are so arranged as not to interfere with the quality of the concrete delivered. Inspection is also maintained over the preparations preparatory to placing concrete, on its deposition in the forms, on the removal of the forms and on its final finishing.

As a check on the correctness of the proportions used and the methods pursued, specimens of the concrete produced are obtained for test periodically. The test specimens are six or eight-inch cylinders. They are taken directly from the wet concrete already in place in the forms and are moulded and cured under standardized conditions. Some are tested when seven days old, others when twenty-eight days old, by crushing them to destruction in a hydraulic press and noting the force required to accomplish this.

Preliminary to actual construction the laboratories examine all available materials and determine those suitable for use. When construction is about to begin they make further studies to determine the proportions which will give concrete of the different classes to be used. During construction a concrete engineer from the laboratories is assigned to the staff of the resident engineer in charge of the job to assist him with the concrete work. Thus at all times close contact is kept between the laboratory and the field.

A field laboratory is installed on each of the larger jobs. This laboratory is equipped with apparatus to carry out the necessary tests and to get the information needed in setting the proportions. The required apparatus is simple and of slight cost and requires but small space to house it. The tests likewise are simple and cheaply made. A typical field laboratory is shown in Figure 1.

The concrete laboratory of the commission is very completely equipped for the investigation of problems in connection with concrete, and is staffed with men especially trained in this work. It is recognized everywhere as one of the leading centres of advanced research in concrete. The results of many of its studies have been published and requests for these pulications have come from all parts of the world. In maintaining this work the commission has, therefore, not only benefitted itself but also the public, for in assisting in the improvement and cheapening of a material used so largely in construction and especially in large public works, the public will in the long run derive the benefit.

# Prompt Service in Manufacture of Steel Pipe

## Dominion Bridge Co. Creates Record in Fabrication and Shipment of 1700 ft. of Sewer Pipe

What may be considered as a record in the fabrication and shipment of riveted steel pipe was recently made in the extension of the Keele Street sewer at Sunnyside, Toronto, by the Dominion Bridge Company. The extension consisted of three pipes, each 560 feet long, two of these 90 in. in diameter and the third one 60 in. in diameter. The total weight of the contract was 612,000 lbs. The inland ends of the three pipes are in the form of thimbles built into a concrete wall. The outer ends pass through the crib work which has been put in place as a retainer for the new "Marginal Way." The pipes are not quite straight throughout their length; they each have two elbows, but the angle of deflection at these elbows is less than 3 degs.

The three thimbles were required in advance so that they could be set in the concrete, but the shipment of the balance—practically the whole of all three pipes—was called for to be made at one time, and not later than November 1st, under penalty.

The contract was awarded to the Dominion Bridge Company on September 30th. On account of the character of the work, the company decided to fabricate the pipes at its Lachine plant, where their boiler department is completely equipped for this work. The specification called for boiler quality material. The orders for this material were mailed on October 1st, the day after the awarding of the contract. Prints of the shop drawings were mailed for approval on October 4th, four days after the date of the contract. The material was rolled promptly in the mills and was received at the Lachine plant between the 17th and 20th of October. The thimbles were shipped within the stipulated time. The final shipment of the pipe was made from Lachine on October 29th and consisted of 29 carloads, each car containing one or two lengths of pipe about 40 feet long. The ends of each section were fitted with flange angles bent to a circle and welded, their outstanding legs being drilled for connecting bolts. This final shipment actually arrived in Toronto at twenty minutes past three on the afternoon of Sunday, October 30th, that is, two days earlier than the date on which the pipe was called for to be shipped from Lachine.

Twenty-nine carloads of steel pipe for Keele st. sewer, Toronto.

The accompanying photograph shows the final shipment. The angle of the camera was not quite wide enough to take in the whole 29 cars. The record made on this contract illustrates what is possible with coordination and co-operation in the placing of orders, the rolling of the raw material, the preparation of the drawings, "up to the minute" methods of fabrication, and enthusiastic hard work in all departments, together with prompt handling on the part of the railway companies.

# Construction of Pulpwood Flumes

## The Design Features Applying to the Erection of Timber Flumes For the Transportation of Logs—Material and Labor Required per Mile of Structure

By J. D. GILMOUR and J. TURNER, Anglo-Newfoundland Development Co., Ltd., Grand Falls, Nfld.

The value of the flume as a means of transportation for logs and lumber has been fully recognized in the West for some time, immense stands of heavy timber making the expenditure of large sums for logging and transportation plant not only possible and profitable, but very often unavoidable. The flume, on account of its comparative cheapness of construction and flexibility of line and grade, as well as its great saving in operating costs, has become the strongest competitor of the logging railroad.

In the East, with much smaller and more scattered timber, the economy of the flume is not so readily apparent. Instead of replacing railroads and other relatively expensive transport systems, the flume must compete with the snow or iced logging road and the horse or tractor drawn sled. Any logging operator sees the economy of investing heavily in plant to tap an area carrying possibly one to two hundred thousand feet, or even more, per acre; but he is less ready to tie up much money in opening up a few square miles of pulpwood running from ten to fifteen cords per acre. Especially when it is quite feasible to log the area with a small investment in mobile equipment, which he can move somewhere else when one block is logged.

In spite of the rather high first cost of a flume, there is no doubt that in every logging region of importance, east as well as west, there are some stands which can only be logged economically by means of flumes, and many others in which fluming will show a considerable saving over any other system of transportation. It is not suggested that fluming is in all cases—or even in the majority of cases—the most economical method of handling logs, but there are many cases where fluming will show a great saving.

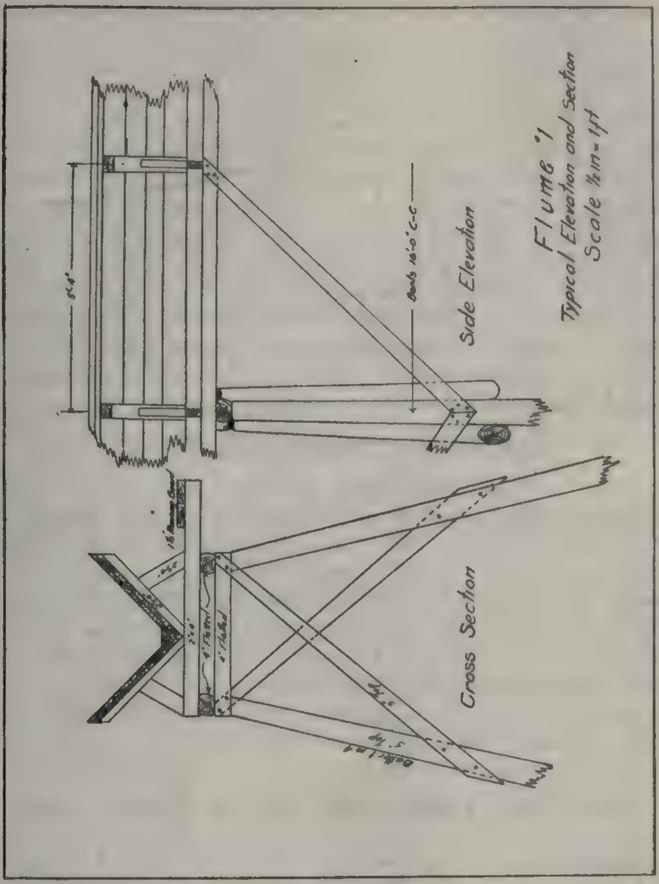
### Fluming vs. Sled Hauling

It is impossible to lay down any general rules as to when fluming has an advantage over sled-hauling. In every operation there are many points to be considered separately, and many items of cost to be weighed before a decision can be reached. Most operators have fairly close cost figures on the construction and operation of main hauling roads under winter conditions. The purpose of this article is to make it possible to deduce, in any circumstances, corresponding figures for fluming. A study of local conditions and intelligent comparison of costs should show which method of transportation is likely to prove most economical.

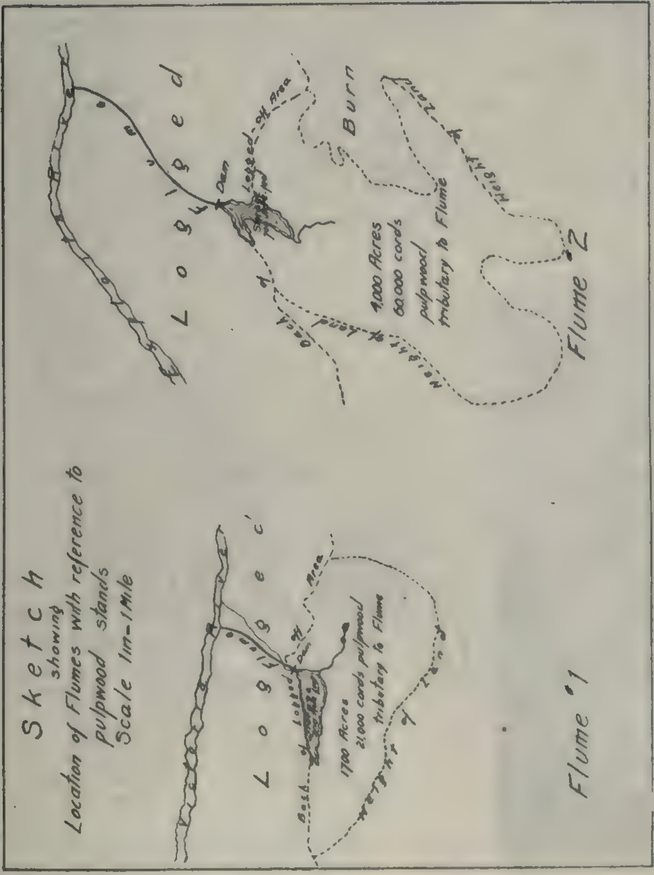
During the seasons of 1919 and 1920 the writers built for the Anglo-Newfoundland Development Company, Ltd., two flumes, both of which have been successfully operated. Most careful accounts were kept of construction and operating costs, and from these this article has been compiled. The figures given may be considered reliable, and are applicable to similar conditions, or may be adjusted to suit varying circumstances. As measures of time and quantity are much more useful than figures in dollars and cents in these times of fluctuating prices, the former alone are used.

Both these flumes utilize the water of streams far too small to drive in the usual way. With regard to the quantity of water required, we can safely say that it is much less than anyone, not conversant with flumes, would suppose. Flume No. 1, described hereunder, ran full continuously for forty hours out of a pond with an

On the left is shown a typical low section of flume No. 1 looking down stream. On the right is a close-up view of the same flume during construction. The logging is finished, the lining and stop still to be placed. The height here is about 12 feet from the ground.



Flume No. 1 showing typical cross section and side elevation.



Sketch showing location of flumes with reference to pulpwood stands.

area of 300 acres, and reduced the water-level less than one and one-half inches.

Neither of these flumes was absolutely necessary—that is to say, the timber might readily have been hauled out. A main hauling road ran to the head of the shorter flume. As this property had all been cruised, reliable figures were available showing exactly how much timber was tributary to the proposed flume. This point is important—the flume is a large and immovable investment, and must be written off proportionately for each cord transported. As this is the chief transportation cost it is important to know how much timber there is tributary to the flume, in order that the estimate of cost may be correct, or at least on the safe side. It was considered that the cost of horse hauling, browing on the banks out of reach of ice, and rolling in the spring after the ice went out, justified the use of a flume instead. Experience has proved the correctness of this idea.

General conditions in the case of both flumes were similar: fair bodies of pulpwood; small ponds giving sufficient log and water storage; sites where comparatively cheap dams could be built; a drop along the proposed lines which, although less than is usually recommended, was enough; a route which offered no serious obstacles to flume construction.

### How Flumes Were Laid Out

These flumes were located and laid out by the methods employed for logging railroads. Stakes were set at intervals of one hundred feet on tangents, and fifty feet on curves. At each stake a plug was driven, and after plotting the profile and establishing the grade, the height to cut-off was marked on the stake.

Except in very difficult country the location of a flume does not demand a very high order of engineering. Regularity of grades is more important than the exact and smooth location of curves, unless the curves have exceptionally short radius. Granted a fair working knowledge of grades and curves, the main requirements are common sense and a practical knowledge of logging and construction methods.

The following table gives the more important details of the flumes, which, although they varied somewhat, differ in no essential particulars:

| | Flume No. 1 | Flume No. 2 |
|---|---|---|
| Type of Flume | V. 90° angle at vertex | V. 90° angle at vertex |
| Timbered area tapped | 1,700 acres | 4,000 acres |
| Timbered tributary, at least | 21,000 cords | 60,000 cords |
| Horse-haul replaced | 1.75 miles | 2.84 miles |
| Water stored | 300 acre feet | 700 acre feet |
| Length of flume | 5,500 feet | 11,200 feet |
| Slant depth | 30 inches | 24 inches, and 30 on flat grade |
| Total fall | 107 feet | 217 feet |
| Average grade | 1.95% | 1.94% |
| Steepest grade | 5.00% | 4.60% |
| Flattest grade | 0.70% | 0.50% |
| Total curvature | 81 degrees | 372 degrees |
| Sharpest curve | 7 degrees | 8 degrees |
| Average height to bottom of cap | 6 feet | 8 feet |
| Greatest height to bottom of cap | 12 feet | 16 feet |
| Trestle legs | Round to 5" top | Round to 5" top |
| Caps and stringers | 4", flatted | 4", flatted |
| Brackets, arms and braces | 2" x 4" | 2" x 4" |
| Box | 2 layers 1" r'gh | 2 layers 1" r'gh |
| Stop | 3" x 3" sawn diagonally | Nil |
| Sway and lateral braces | Round 3" top | Round 3" top |
| Av. speed of log, approximate | 7½ miles per hr. | 7½ miles per hr. |
| Capacity per hour | 30 cords | 35 cords |

The dams were built before flume-building was started. These were the ordinary crib type. A narrow opening was left to receive the head of the flume. The arrangement of stop-logs is such that the upper section of the flume may be raised or lowered to accommodate the flume to the varying levels of water in the pond. A sluice-way and lift-gate takes care of excess water, and allows the dams to be unwatered for inspection or repairs.

A supply of logs for construction was hauled to a point near the head of the flume, where a small sawmill was located, so that lumber could be placed in the flume with minimum of handling. Sawing must be commenced some time before actual construction, so as to ensure against delays.

### How the Gang Was Distributed

No road is required for the distribution of building material. The flume is started at the dam, and all material is carried to the work in the completed portion of the flume. It was found that the best results were obtained by using a gang distributed as follows:

| | |
|---|---|
| Cutting, framing and erecting crib and bents | 5 men |
| Placing stringers, cutting and erecting sway and lateral bracing | 4 men |
| Assembling brackets | 1 man |
| Building box | 6 men |
| Placing running-board and stop | 1 man |
| Odd jobs | 2 men |
| Foreman | 1 man |
| Total | 20 men |

As it became necessary, the foreman laid out a section of flume ahead, by driving stakes at sixteen-foot intervals to mark the bent centres, and setting stout poles about every two hundred feet, with nails driven to mark the bent cut-off line. A line stretched between these nails gave the proper cut-off for each bent.

All bents were built on mud-sills, made of any timber convenient to the line. To get the cut-off for trestle legs a template was made. This was merely a light board, graduated in feet and inches, with a shorter board nailed to the bottom. When the shorter board lay on the mud-sill the graduated board stood at the same batter as the trestle-legs, and the intersection of the taut line previously described, with the graduated board, gave by direct reading the required length of trestle-leg.

It was found best to frame bents on the ground and erect them as units. As soon as a bent was raised stringers were run out from the previous bent, spiked on, and the sway and lateral bracing completed.

In building the box, sixteen-foot lumber exclusively was used for the first layer, or lagging. The second layer, or lining, was in some cases shorter. The lining was fastened by nailing through from outside of lagging and clinching nails downstream so that running logs will keep them tight, even after the lining wears thin. All joints were broken, and seams lapped.

Material was flumed from time to time, usually enough for half a day's work on construction.

### Quantities of Material and Labor

Flume No. 1 was built during a particularly dry season and the water-supply failed with two thousand feet still to build. Two rather unique trucks were built on the job to run inside the flume. These were small wedge-shaped trucks, each equipped with three pairs of wheels, one pair of which ran tandem on the stop, and one pair on each side ran against the side of the flume. Loads of course were only required to run down-grade; as two men could handle five hundred feet of lumber at a load, very little delay resulted from the shortage of water.

### Material and Labor for One Mile of 30-inch Flume

| | |
|---|---|
| Material | |
| Round timber to 5-inch top (trestle legs) | 20,000 ft. B.M. |
| Round timber to 3-inch top (bracing) | 12,000 L.F. |
| 4″ flatted (caps and stringers) | 20,000 ft. B.M. |
| 2″ x 4″ (brackets) | 8,000 ft. B.M. |
| 1″ (box) | 58,000 ft. B.M. |
| 1½″ (running board) | 3,000 ft. B.M. |
| 3″ x 3″ (stop) | 3,000 ft. B.M. |
| 6″ nails | 1,000 lbs. |
| 4″ nails | 300 lbs. |
| 3″ nails | 400 lbs. |
| 2½″ nails | 300 lbs. |
| Labor— | |
| Cutting, framing and erecting cribs and bents | 70 man-days |
| Placing stringers, cutting and erecting bracing | 56 man-days |

Building a typical high section on flume No. 1, showing trestling and bracing to good advantage. This construction appears frail but has proven very stiff in service and perfectly satisfactory in every way.

| | |
|---|---|
| Assembling and placing brackets | 14 man-days |
| Box | 84 man-days |
| Running-board and stop | 14 man-days |
| Handling material, etc. | 28 man-days |
| Foreman | 14 man-days |
| Total | 280 man-days |

A 24-inch flume requires almost as much labor, there being a little saving only in box construction. Where height to cut-off can be kept below 3½ feet bents may be replaced by cribs but in all heights over that bents were found to be cheaper. It was found also that, within reason, the heights of bents makes hardly any difference in the cost, the difference, for example, between bents five feet and fifteen feet high being negligible.

Under favorable conditions the 30-inch V-flume carries 50 cords pulp logs per hour. This spring 5,127 cords were flumed out of Flume No. 1, the average maintained for the whole period the fluming gang was employed being 275 cords per day of ten hours. This included 3 days preparing booms, getting logs down the pond, and small repairs to dam; and includes several unfavorable days, with adverse winds, which prevented the flume getting a full supply of pulpwood.

The actual fluming required two patrolmen and one to two men feeding the logs into the flume.

The logs flumed had a maximum length of 16 feet, and the longer lengths gave the greatest output in fluming. Of course a flume with a maximum curvature of eight degrees will carry logs fifty feet long just as well.

The illustrations in this article show typical sections of the flume, while the two sketches depict the topography of the district.

# Industrial Relations in Construction

## Lack of Mutual Interest and Sympathy Tends to Develop by Reason of the Uncertainties of the Building Industry—Elimination of Seasonal Fluctuations Will Develop Continuity of Employment—How Public Opinion Acts

By ERNEST T. TRIGG, President, National Federation of Construction Industries, before Academy of Political Science and the American Industrial Relations Association

The development of satisfactory relationships between the various elements in industrial organizations without plants offers many difficult problems. The construction industries of this country present by far the largest group of activities of this type. The workers in them move from project to project, and are not permanently located in production plants. The clothing industry also contains many workers who can be classified as not working in regularly constituted industrial plants. This class of workers take work from contractors, usually petty contractors, and perform it in their homes or small shops, which are of such a rudimentary character that they can scarcely be called plants. In addition to the industries mentioned there are groups of workers such as those catering to construction groups, loading and unloading vessels, harvesting, berry gathering, etc., which undoubtedly require special treatment under the general subject with which I am dealing.

### Conditions Inherent to Industries Without Plants

The construction industries being the largest and most important group without plants, I shall confine my discussion largely to that field. These industries, when the entire field of construction and the manufacture of materials required therefor is taken into consideration, form the second largest group on the continent. They are exceeded only by the group of agricultural industries. In addition to this, the construction industries are pre-eminently important because it is through them that the most of the permanent wealth of the country is created and put into material form.

The problems in industrial relations, which are peculiar to the construction industries and which do not so largely apply to those having permanent plants, in greatest measure revolve about the fact that in these industries the working forces of the employers are apt to vary widely and rapidly. In many types of construction the employer maintains only a small nucleus organization as a permanent force. He then employs and discharges the great bulk of his employees as the exigencies of his work demand, most of the workers being in the nature of temporary employees. Thus a large building firm may, by reason of the pressure of many large contracts, have a short time thereafter a comparatively few. Employment, under these circumstances, offers but little opportunity for managers and workers to become well acquainted and interested in one another, that is, except so far as relates to the permanent nucleus of the working force.

In many cases, construction work performed by large contractors covers wide territories. A project carried through at a location distant from the contractor's head quarters will have most of the labor recruited locally, possibly only a superintendent and a foreman or two of the employer's permanent staff being used. This wide range of location of construction work carried on by an employer, combined with the varying size and constituency of the personnel, represent the special conditions to be dealt with.

### Effects and Results

It is but natural that there should often be a lack of mutual interest and sympathy between an employer and his men under conditions such as have been outlined above. The employer is not likely to feel the same sense of responsibility for the welfare of the temporary force in his employ as in the case of an employer operating a permanent plant where the working force is largely stable and the individual workers are more or less intimately known by the management. In addition to this, a contractor doing a project at a distance from his headquarters is not so liable to feel the potential power of public opinion as is ordinarily the case where there is a permanent plant. These conditions all tend to encourage the selfish and unjust contractor to impose upon his men and make it difficult for the reliable and responsible contractor to set up the relationships which will be most useful in forwarding both his own, his workers', and the public's best interests.

The same lack of contact between the employers and the mass of the workers in the construction industries tends strongly to encourage the organization of trades associated therewith under closed shop conditions. The result of this has been that the construction industries—the building industries in particular—have been seriously interfered with through the imposition of sympathetic strikes, strikes called for the purpose of organizing labor, jurisdictional strikes, the boycott, restriction of output, and other industrial ills. These practices have been seriously injurious and unfair to the public, hurtful to employers, and costly to the employees themselves.

As a counter to this distinctly antagonistic and injurious form of labor organization, there has developed a movement for the strong organization of contractors by communities. In places where the organization of both labor and employers has been highly perfected, and the two organizations have fallen into unscrupulous hands, the result has sometimes been disastrous. With these two groups thoroughly organized and working together, it has been found possible by unprincipled leaders largely to eliminate competition, and substitute unhealthful and unjust regulations of prices and wages. Illustrations of conspiracies of this kind which have been carried on at the expense and to the injury of the public can be obtained by reference to the records of legal prosecutions in some of our cities. The fact that the local contractor has an advantage over one from a distance, by reason of his having his organization and equipment on the ground, tends to reduce competition from the outside and to increase the possibility of unjust combination. There is usually little likelihood of community conspiracies of this kind in the production of commodities in permanent plants by reason of the competition which comes more readily from other communities.

### Some Primary Problems

The first problem of great importance to work out is methods which will overcome the obstacles to reasonably sympathetic and helpful relationships between employer and employee. In the construction industries one of the most important items of this problem is that of developing greater continuity of employment, which would not only bring greater prosperity and contentment to the worker, but would also tend in some measure to stabilize employment. At the very best, there will be periods when the weather will prevent outdoor operations, but this seasonal interference with continuous work has been magnified by practice and habit. Thus, it has been common for wage contracts to be made as late as May first, thus interfering with the early signing of contracts. Habit has further tended toward the instituting of work in the spring. There seems to be no good reason why wage scales for the ensuing year, where wage scales are necessary, should not be established in the fall, or at the latest by the first of the year. This would enable those having building projects in hand to make contracts in the fall or early winter.

The result of this would make possible the ordering and delivering of materials and the starting of work by the earliest possible moment in the spring. Early letting of contracts in this way would not only be more advantageous by extending the period of activities in the coustruction industries, but it would also reduce the intermittent or seasonal character of the industries engaged in the manufacture of construction materials and supplies, and of railroad transportation. Improvement may also be made in the matter of getting new building construction under cover before cold weather, in order that as much activity can go on through the winter as is possible.

Further, in connection with increasing continuity of employment, advantage may be obtained by educating the public to the habit of placing orders for inside repairs and building work so that it can be done during the winter months. Much work of this kind is now put on foot in the spring—the period set by custom for general cleaning and sprucing up. Could not the contractor encourage a movement in this direction by offering special inducements in the form of reduced prices, etc.? Their overhead costs would be reduced by more continuous use of their equipment and administrative organizations, and material and supplies manufacturers would doubtless be tempted to lower prices for delivery in the winter for a similar reason.

Mr. Hoover has recently taken measures to forward the project of letting public road contracts in the fall, in order that the preparation and distribution of road materials can go on through the winter.

### Training of Employees

A primary element relating to proper relations between employers and employees in this industry also rests upon the preparation of well trained mechanics and artisans who are not only qualified to give satisfactory service to their employer, but are able also, by reason of their skill and qualifications to earn generous wages. Our schools have done much to aid in this. Extensive studies have shown that those who have had the benefit of properly devised trade or industrial school training in connection with their training in the field have advanced in their earning power, on the average, well beyond those who have lacked this broad preparation. But in spite of the great advances which have been made, the project is still in an embryo state and, as is asserted by many experienced engineers and contractors, our construction workers lack the training necessary for their own best interests and that of their employers. Not only should the training be satisfactory, but there should be an adequate number of skilled workers to supply the needs of industry. This point stands out clearly at the present time with regard to the construction industries, where the number of skilled workers in the building trades is out of balance, as is evidenced by the great shortage of plasterers in some districts. Is it not possible for communities to give sufficient consideration to this situation to make possible the right training of at least approximately the needed numbers of workers in each trade?

The relations in the construction and similar industries should be so worked out that there will be no tendency toward nor need felt for the creation of closed shop labor organizations, with their attendant ills. It is equally important that the employees be protected against the selfish employer. Ordinarily labor should be protected in this regard by competition for his services, and his ability to leave the employ of an unsatisfactory employer and obtain work elsewhere. Though this natural method to a large extent serves the purpose, it, nevertheless, leaves many cases where injustice and bitterness prevail. It is these cases which in a large measure are responsible for most of the industrial ills spoken of.

### The Removal of Undesirable Causes and Effects

There seems to have been, as yet, no formal solution worked out for solving the primary problem of right relationship between managements and men, particularly in industries without plants, which has as yet fully met the situation.

Various plans are being used by employers in industries which have plants. Some of these plans give promise of solving difficulties in relationships to a large extent, though it must always be borne in mind that the success of any system in any shop depends largely upon the capacity and leadership of the management. Such schemes as workers' representation, etc., are easily adaptable as machinery for aiding in the establishment of good relations where the force is reasonably permanent both in personnel and location. On the other hand, such methods are not so readily adaptable to the case of the contract of short duration requiring a large body of local labor often far removed from the employers' headquarters.

There have been various governmental systems established for the maintenance of justice and for settling disputes for all industries, including those without plants. As a rule, they have been indifferently successful. In most cases the plans have been based upon compulsory, partially compulsory, or voluntary arbitration. The systems in Australia and New Zealand may be more or less accurately listed in the first class, while in the second class may be placed Canada. The United States may be considered to be in the last class.

### Results of Arbitration

The results gained in these various countries have not been so eminently satisfactory as to warrant the acceptance of any one of the systems as a full solution of the problem of industrial relationships. In both Australia and New Zealand the systems have worked out reasonably well, except at certain times of crisis. In Canada there have been many differences in spite of the governmental system. In America voluntary arbitration, either set on foot through governmental agencies or through private initiative, has been of material service, but here again it is apt to fail in serious crises. Arbitration seems to work well when it results in increases of wages, and often unsatisfactorily when wages are decreased.

Apparently arbitration boards created for each special case, upon the basis of representatives from the two sides to the controversy and a non-partisan third party, do not have the germs which can develop into a fully successful practice. This may be partly because the arbitrators are usually unskilled in judicial functions, and partly by reason of the fact that special boards do not provide a suitable, permanently established organization to which resort may be had at any time for the redress of grievances.

The Kansas Industrial Court, on the other hand, eliminates some of the objections which are applicable to temporary arbitration boards, insomuch as it is a permanently established court having the backing and power given to all the other courts of that state.

One of the most prolific sources of difference between labor and management has been the lack of legal responsibility of unchartered or unincorporated groups or associations in many of our states. Thus, when an unscrupulous man has been able to force his way to the head of an unincorporated organization or group of labor, he has reached a place of power where he may force unjust demands by strikes or threats of strikes, with reasonable hope of immunity from the law, for which an individual or an incorporated group would be held strictly to account. A suitable modification of the law affecting this situation and of legal practice in regard to holding those who cause strikes or lockouts which are in breach of contract, whether individuals or groups, legally liable to damages, might be of material service in eliminating the irresponsible leaders who have been so large an element in the creation of bad blood and relationships in industry. The elimination of leaders of this character would be as helpful to labor as it would to employers and the public.

### Public Opinion

And all of these established methods or suggestions may prove of value, but they are after all merely inert implements for aiding in the attainment of an end. The great vital force which will and can compel right relationships is that of public opinion. Without the strong backing of a well crystallized public opinion no system, however devised and however helpful, will prove successful. With the full backing of a properly educated and intelligent public opinion proper relationships will prevail, even though the implements at hand may be of poor quality. This is rather strikingly illustrated by the railroad situation in the United States. The Railroad Labor Board is the most formal national body in the country having responsibility for settling labor disputes, and it has the advantage of being a permanently formed body, surrounded by experts and the paraphernalia needed to enable it to deal wisely with the problems which are brought before it. Nevertheless, the memory of the threat of a disastrous railroad strike which came as a result of a decision of this board and the fear of future unaccepted-able decisions is still fresh in our mind. There is no doubt but that the strong, unfavorable public opinion prevented a realization of this threat. More than anything else, I feel convinced that public opinion is the final agency upon which we must depend in controlling and regulating industrial relationships. A more complete development of public opinion and its responsibility in the situation seems to me important.

The growth of stable and sound labor relations would also doubtless be forwarded by reverting to a greater measure of community action, with an accompanying resultant decentralizing of our industrial affairs. In France much is accomplished in the maintenance of good-will and proper relationships through the adoption of this principle. The system there does not prevent great national disturbance, but it has gone far to teach the people of communities to settle their problems in a civil way as against the warlike use of strikes. An active, sane mobilization of the best elements in every industrial community would go far toward developing, throughout the country, the wide spread understanding and knowledge which is necessary for industrial peace and welfare in all kinds of industry.

# The New R.C. Church at Louisville, P.Q.

### Commenced in 1915, This Imposing Edifice, Which Seats Nearly Two Thousand People, Has Been Completed at a Cost of Over $300,000. A Creditable Example Not Only of Local Design, but Also of Local Workmanship and Materials

The Roman Catholic church at Louisville in the province of Quebec, which has just been completed at a cost of three hundred thousand dollars, is a particularly noteworthy structure of its kind in this section of the country.

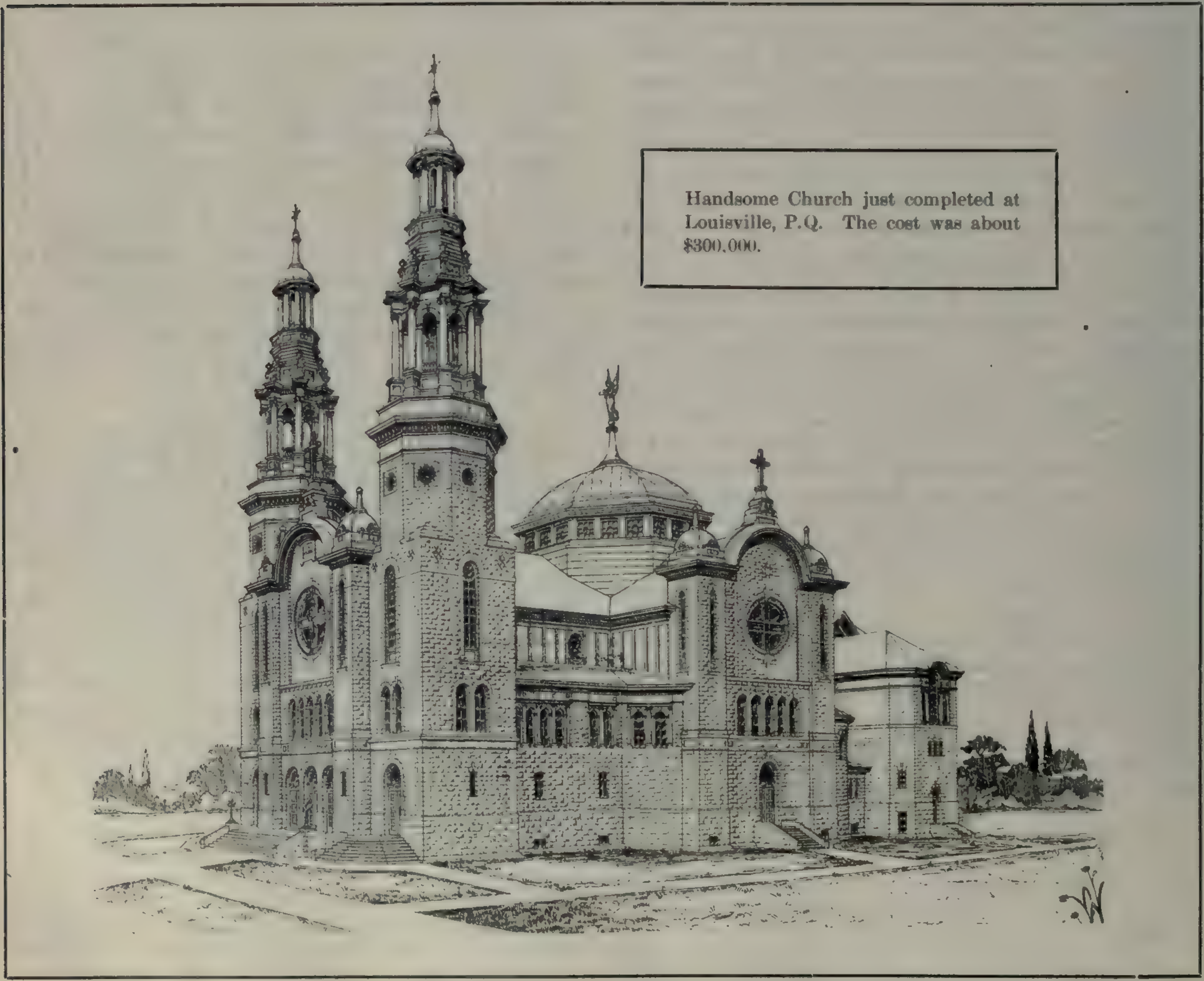
The new building replaces an old church which had become inadequate for the requirements of the present population of St. Antoine de Louiseville. It is erected on the site of the old structure and was built according to plans and specifications prepared by Mr. P. Levesque, of Quebec City. The structure is 120 feet by 212 feet in exterior dimensions.

An interesting feature of the new church is the dome, over the roof of the nave and transepts. This dome is surmounted by the statue of an angel fourteen feet high. (See our illustration).

The exterior of the church is of gray granite from Riviere a Pierre. The limestone trimmings are from Joliette. Over the main entrance there is a terra-cotta rose-window combined with a niche where there is placed a statue representing St. Antoine, the patron saint of the parish. The two crosses at the top of the steeples are 180 feet from the ground level.

The interior of the building is finished in plaster. The church is lighted by electricity and is steam-heated. The total seating capactiy is 1,820 persons.

The general contract for the new church was awarded in the first instance to Joseph Couture, of Levis, Que., and operations were commenced in September, 1915. Subsequently the work was carried on by day labor under the supervision of Mr. J. R. Paquette. When the building was finished last June the total cost amounted to $315,000.



Handsome Church just completed at Louisville, P.Q. The cost was about $300,000.

# Water Power Development

## All Parts of the World Involved in an Unprecedented Investigation of the Value of Water Power Resources—Uses of Hydro-Electric Energy Rapidly Increasing.

By Prof. A. H. GIBSON, D. Sc., before the British Association.

(Continued from last issue)

The figures already quoted indicate that the scope for inland water power development throughout the world, and more particularly throughout the British Empire, is likely to be large for many years to come, and it is gratifying to know that British engineers are prepared to play a large part in such development work.

The utilization of this water power is likely to give rise to some economic problems of interest and importance. When industrial conditions have again become stabilized, the competitive ability of the various nations will depend largely on economy in the application of energy to production and transportation, and the possession of cheap water power is likely to counterbalance the posession of such resources as coal and iron as a measure of the industrial capacity of a nation.

While it is probably true in industrial communities that the most attractive water power schemes have already received attention, many of those available in countries which have hitherto been non-industrial are capable of extremely cheap development and will certainly be utilized as soon as a market for their output can be assured.

It is in such countries that the result of these developments is likely to be most marked, and will require most careful consideration. Thus the hydro-electric survey of India now being carried out by the Indian Government indicates that very large water power resources are available in the country, and that, although a few large schemes have been or are being developed, the resources of the country are practically untouched. There can be little doubt that in the course of time a large amount of cheap energy will be available in India for use in industrial processes, and as the country possesses a large and prolific population readily trained to mechanical and industrial processes, along with ample supplies of raw material for many such processes, all the conditions would appear to be favorable for its entry into the rank of manufacturing and industrial nations.

### Modern Tendencies in Water-power Development

The large amount of attention which has been concentrated on the various aspects of water power development during the past ten years has been responsible for great modifications and improvements in the design, arrangement, and construction of the plant.

Broadly speaking, these have been in the direction of increasing the size, capacity, reliability, and efficiency of individual units; of improving the design of the turbine setting and of the head and tail works; of increasing the rotative speed of low head turbines; of detailed modifications in the reaction type of turbine to enable it to operate under higher heads than have hitherto been considered feasible; and of increasing the voltage utilized in transmission.

The capacity of individual units has been increased rapidly during recent years, and at the present time units having a maximum capacity of 55,000 horsepower under a head of 305 ft. are being installed in the Queenston-Chippewa project at Niagara, while units of 100,000 horsepower are projected for an extension of the same plant.

These modern high-power turbines are usually of the vertical shaft, single runner type, with the weight of the shaft, runner, and generator carried from a single-thrust bearing of the Michell type. This type lends itself to a simple and efficient form of setting, while the friction losses in the turbine are extremely low. As a result of careful overall design it has been found possible to build units of this type having an efficiency of approximately 93 per cent.

One of the great drawbacks of the low head turbine in the past has been its relatively slow speed of rotation, which necessitated either a slow speed, and consequently costly generator, or expensive gearing. As a result of experiment it has, however, been possible so to modify the form of the runner as greatly to increase the speed of rotation under a given head without seriously reducing the efficiency.

Investigations in this direction are still in progress and promise to give rise to important results. At the present time, however, turbines are in existence which are capable of working efficiently at speeds at least five times as great as would have been thought feasible ten years ago.

### Welded Pipe for High Heads

The non-provision of a suitable pipe line has, until recent years, tended to retard the development of plants for very high heads. Under such heads the necessary wall thickness, even with a moderate pipe diameter, becomes too great to permit of the use of riveted joints. Recent developments in electric welding and oxy-acetylene welding have, however, rendered it possible to construct suitable welded pipes, and by their aid, and by the use of solid-drawn steel pipes in extreme cases, it has been found possible to harness some very high falls. The highest as yet utilized is at the Fully installation in Switzerland. Here the working head is 5412 ft., corresponding to a working pressure of 2360 lbs. per square inch. The pipe line is 19.7 in. in diameter and 1¾ in. thick at its lower end, and each of the three Pelton wheels in the power house develops 3000 horsepower, with an efficiency of 82 per cent.

Until comparatively recently the Pelton wheel was looked upon as the only practicable turbine of high heads, and the use of the Francis turbine was restricted to heads below about 400 ft. This was due partly to the fact that a reaction turbine of comparatively small dimensions gives a large output under a high head, and except in turbines of comparatively large power the water passages become very small and the friction losses in consequence large.

A further and more important reason for the general choice of the Pelton wheel for high heads was the fact that in the earliest Francis turbines, when operating under heads involving high speeds of water flow, corrosion of the runner was very serious. This corrosion is now generally attributed to the liberation of air containing nascent oxygen at points where eddy formation causes regions of low pressure. Careful design of the vanes has enabled this to be largely prevented in modern runners, and in consequence the field of useful application of the Francis turbine has been extended until at present turbines of this type are operating successfully under a head of 850 ft., and this limit will probably be exceeded in the near future.

The great increase in all constructional costs since 1914 has increased the cost of the average hydro-electric plant by something of the order of 150 per cent., and since the cost of energy produced by such a plant is mainly due to fixed charges on the capital expenditure this cost has gone up in an even greater proportion owing to the higher interest charges now demanded.

It is true that the same increased cost applies within narrow limits to the output from every steam plant erected since the war, and the relative position of the two types of power plant with coal at about 25s per ton is much the same as before the war.

The fact remains, however, that a newly constructed hydro-electric plant has often to compete in the market with a steam plant built in pre-war days whose standing charges are comparatively low, and in order to enable it to do so with success the constructional cost must often be reduced to a minimum compatible with safe and efficient operation. With this in view many modifications in design and construction have been introduced in recent plants, but there would still appear to be ample scope for investigation into the possibility of reducing the first cost by modifying many of the details of design and methods of construction now in common use.

### Modification in Plant Design

Among recent modifications in this direction may be mentioned:—

1. The elimination of the dam in storage schemes in which natural lochs or reservoirs are utilized, this water level being drawn down in times of drought instead of being raised in times of flood. This reduces the cost of construction appreciably in favorable circumstances and eliminates the necessity for paying compensation for flooding of the land surrounding the reservoir.
2. The substitution, where feasible, of rockfill dams for those of masonry or monolithic concrete.
3. The introduction of outdoor installations with the minimum of power house construction.
4. The simplification of the power plant.

Some progress has already been made in these directions, and it is probable that experience based on recent installations and experimental investigations will enable considerable further progress to be made.

### Research in Hydro-electric Problems

There are few branches of engineering in which research is more urgently required and in which it might be more directly useful.

Among the many questions still requiring investigation on the civil and mechanical side may be mentioned:

1. Turbines.—Investigation of turbine corrosion as affected by the material and shape of the vanes.

Effects of erosion due to sand and silt.

Resistance to erosion offered by different materials and coatings.

Bucket design in low head high-speed turbines.

Draught tube design.

Investigations of the directions and velocities of flow in modern types of high-speed turbines.

Investigation of the degree of guidance as affected by the number of guide and runner vanes.

2. Conduits and Pressure Tunnels.—The design of large pipe lines under low heads with the view of reducing the weight of metal. The investigation of anti-corrosive coatings, so as to reduce the necessity for additional wall thickness to allow for corrosion.

Methods of strengthening large thin-walled pipes against bending and against external pressures.

Methods of lining open canals and of boring and lining pressure tunnels.

Effects of curvature in a canal or tunnel.

3. Dams.—Most efficient methods of construction and best form of section especially for rockfill and earthen dams. Best methods of producing water tightness.

4. Run-off Data.—Since the possibility of designing an installation to develop the available power efficiently and economically depends in many cases essentially on the accuracy of the run-off data available, the possession of accurate data extending over a long series of years is of great value.

While such data may be obtained either from steam gaugings or from rainfall and evaporation records, the former method is by far the more reliable. For a seasonable degree of accuracy, however, records must be available extending over a long period of years, and at the present moment such data are available only in very few cases.

Where accurate rainfall and evaporation records are available it is possible to obtain what is often a sufficiently close approximation to the run-off, but even rainfall records are not generally at hand where they are most required, and even in a district where such records are available they are usually confined to easily accessible points, and are seldom extended to the higher levels of a catchment area where the rainfall is greatest. Even throughout the United Kingdom our knowledge of the rainfall at elevations exceeding 500 ft. is not satisfactory, and little definite is known concerning that at elevations exceeding 1000 ft.

In this country evaporation may account for between 20 and 50 per cent. of the annual rainfall, depending on the physical characteristics of the site, its exposure, mean temperature, and the type of surface covering. In some countries evaporation may account for anything up to 100 per cent. of the rainfall. As yet, however, few records are available as to the effect of the many variables involved. An investigation devoted to the question of evaporation from water surfaces and from surfaces covered with bare soil and with various crops, under different conditions of wind, exposure, and mean temperature, would appear to be urgently needed. If this could be combined with an extension of Vermeulle's investigation into the relationship between rainfall, evaporation, and run-off on watersheds of a few characteristic types, it would do much towards enabling an accurate estimate of the water power possibilities of any given site to be predetermined.

Even more useful results would follow the initiation of a systematic scheme of gauging applied to all streams affording potential power sites.

Among other questions which are ripe for investigation may be mentioned:—

1. The combined operation of steam and water power plants to give maximum all-round efficiency.
2. The relative advantages of high-voltage direct-current and alternating-current generation and transmission for short distances.
3. The operation of automatic and semi-automatic generating stations.

### Tidal Power

The question of tidal power has received much attention during the last few years. In this country it has been considered by the Water Power Resources Committee of the Board of Trade, which has issued a special tidal power report dealing more particularly with a suggested scheme on the Severn. The outline of a specific scheme on the same estuary was published by the Ministry of Transport towards the end of 1920.

In France a special commission has been appointed by the Ministry of Public Works to consider the development of tidal power, and it has been decided to erect a 3000-kilowatt experimental plant on the coast of Brittany. With the view of encouraging research, the Government proposes to grant concessions, where required, for the laying down of additional installations.

The tidal rise and fall around our coasts represent an enormous amount of energy, as may be exemplified by the fact that the power obtainable from the suggested Severn installation alone, for a period of eight hours daily throughout the year, would be of the order of 450,000 horsepower.

Many suggestions for utilizing the tides by the use of current motors, float-operated air compressors, and the like, have been made, but the only practicable means of utilizing tidal energy on any large scale would appear to involve the provision of one or more dams, impounding the water in tidal basins, and the use of the impounded water to drive turbines.

The energy thus rendered available is, however, intermittent; the average working head is low and varies daily within very wide limits, while the maximum daily output varies widely as between spring and neap tides.

If some electro-chemical or electro-physical process were available, capable of utilizing an intermittent energy supply subject to variations of this kind, the value of tidal power would be greatly increased. At the moment, however, no such process is commercially available, and in order to utilise any isolated tidal scheme for normal industrial application it is necessary to provide means for converting the variable output into a continuous supply constant throughout the normal working period.

Various schemes have been suggested for obtaining a continuous output by the co-ordinated operation of two or more tidal basins separated from each other and from the sea by dams with appropriate sluice gates. This method, however, can only get over the difficulty of equalizing the outputs of spring and neap tides if it be arranged that the maximum rate of output is that governed by the working head at the lowest neap tide, in which case only a small fraction of the available energy is utilized.

When a single tidal basin is used it is necessary to provide some storage system to absorb a portion of the energy during the daily and fortnightly periods of maximum output, and for this purpose the most promising method at the moment appears to involve the use of an auxiliary high-level reservoir into which water is pumped when excess energy is available, to be used to drive secondary turbines as required. It is, however, possible that better methods may be devised. Storage by the use of electrically heated boilers has been suggested, and the whole field of storage is one which would probably well repay investigation.

If a sufficiently extensive electrical network were available, linking up a number of large steam and inland water power stations, a tidal power scheme might readily be connected into such a network without any storage being necessary, and this would appear to be a possibility which should not be overlooked in the case of our own country.

A tidal power project on any large scale involves a number of special problems for the satisfactory solution of which our present data are inadequate.

Thus the effect of a barrage on the silting of a large estuary, and the exact effect on the level in the estuary and in the tidal basin at any given time, can only be determined by experiment, either on a small installation or preferably on a model of the large scheme.

Many of the hydraulic, mechanical, and electrical problems involved are comparatively new, and there is little practical experience to serve as a basis of their solution.

Among these may be mentioned:

1. The most advantageous cycle of operations as regards working periods, mean head, and variations of head.
2. The methods of control and of sluice gate operation.
3. Effect of changes of level due to wind or waves.
4. The best form of turbine and setting and the most economical turbine capacity.
5. The possibilities of undue corrosion of turbine parts in salt water.
6. The best method of operation; constant or variable speed.
7. Whether the generators shall be geared or direct driven.
8. Whether generation shall be by direct or alternating current.

The questions of interference with navigation and with fisheries, of utilizing the dam for rail or road transport across the estuary, and, above all, economic questions connected with the cost of production, and the disposal of the output of such an installation, also require the most careful consideration before a scheme of any magnitude can be embarked upon with assurance of success.

In view of the magnitude of the interests involved and of the fact that rough preliminary estimates indicate that to-day current even for an ordinary industrial load could be supplied from such an installation at a price lower than from a steam generating station giving the same output with coal at its present price, it would appear desirable that these problems should receive adequate investigation at an early date.

In view of the considerations already outlined, and especially in view of the large part which British engineering will probably play in future water power developments, the provision on an adequate scale at some institution in this country of facilities for research on hydraulic and cognate problems connected with the development of water power is worthy of serious attention.

At present the subject is treated in the curriculum of the engineering schools of one or two of our universities, but in no case is the laboratory equipment really adequate for the purpose in question.

What is required is a research laboratory with facilities for experiments on the flow of water on a fairly large scale; for carrying out turbine tests on models of sufficient capacity to serve as a basis for design; and, if possible, working in conjunction with one or more of the hydro-electric stations already in existence, or to be installed in the country, at which certain large scale work might be carried out.

The provisions of such a laboratory is at the moment under consideration in the United States, and in view of the rapidity with which the designs of hydraulic prime movers and their accessories are being improved at the moment, it would appear most desirable that the British designer, in order that the deservedly high status of his products should be maintained and enhanced, should at least have access to equal facilities, and should, if necessary, be able to submit any outstanding problems to investigation by a specially trained staff.

The extent to which our various heat engine laboratories have been able of recent years to assist in the development of the internal combustion engine, and to which our experimental tanks have assisted in the development of the shipbuilding industry, is well known to most of us, and the provision of similar facilities to assist in the development of our hydro-electric industry would probably have equally good results in this connection.

# Two Spans of Concrete Arch Bridge Fail

## Pier of Third Street Arch Bridge Over the Miami River at Dayton, Ohio, Split and Listed—Examination of Structure After Failure Discloses Badly Corroded Condition of Reinforcement

The recent failure of the Miami River Bridge at dayton, Ohio, is another example of a reinforced concrete arch failing under normal loading conditions and without any warning. Three people were thrown into the river and a motor car and truck were carried down in the collapse. Fortunately, no lives were lost although many persons were on the bridge at the time. A street car passed over just before the accident and one was stopped just short of the collapsed portion.

The bridge spans over the Miami River at Third Street and was built in 1904. It consists of seven reinforced concrete arch spans of the Melan type. It carries a roadway forty-two feet wide, having two street railway tracks in the middle and a ten-foot walk at each side, making a total width of sixty-two feet between handrails. The spans vary in length from eighty feet at the ends to one hundred and ten feet at the middle of the bridge with a rise of approximately one-twelfth of the span. According to the plans and specifications the concrete in the arch barrels is composed of a one-two-four mix, while that of the piers is a one-three-seven mix.

The pier that failed—the second from the east side of the river—is ten feet wide under coping and has a footing twenty feet wide by eighty feet long with the pier footings approximately nine feet below low water. This pier broke in two about thirty-one and one-half feet from the upstream end and canted upstream so as to leave a crack about nine inches in width at the coping and toward the middle of the river about eleven inches measured at the coping.

The portions of spans number two and number three that failed and fell into the river were in the shape of a triangle with the base, about twenty-five feet long, on pier number two and the apex at the handrail on the upstream side of the bridge. Span number two fell almost vertically, carrying a motor car and truck with it. The fall was so direct that the brick paving lay practically intact on top of the debris. In both spans the failure was along the third Melan arch, measured from the centre of the bridge, for a considerable distance, then breaking diagonally across to the handrail.

### Arch Ribs Very Badly Rusted

The steel arch ribs were decidedly rusty where they were exposed by the failure, and it was observed that only about 15 per cent. of the concrete adhered to the arch ribs composed of angles and lattice bars leaving about eighty-five per cent. unprotected. An examination of the whole bridge showed that this was a general condition. The position of each rib could be distinctly determined from the river by the streaks of rust, dripping water or the scaling off of the concrete beneath the steel. Each arch barrel is thus composed of steel girders and unreinforced concrete ribs.

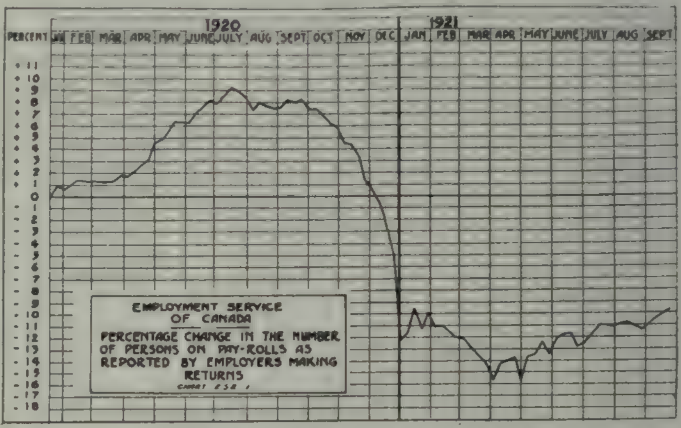
During construction, the bridge was divided into three parts by two construction joints, but although the line of failure crossed one of these joints the break did not follow it, and manifestly the construction joints could have nothing to do with the failure of the bridge. Good concrete was observed both in the pier and in the arch.

Soundings were taken after the accident around pier number two and it was found that the bed of the river was approximately one and one-half feet below the foundation of this pier near the upstream end and the gravel and sand that the pier had been resting on was washed away. This undermining undoubtedly caused the failure of the pier which caused the collapse of the two adjacent spans.

The failure, however, disclosed the fact that the reinforcement is in a very bad state of corrosion, and, as this condition obtains throughout the entire bridge, it is only a question of time till a far more serious collapse will result. This will necessitate replacement by a more permanent type of construction, and it is doubtful if it is advisable to spend the money in repairing this bridge, in view of the fact that the life of the bridge is limited to comparatively few years.

## Unemployment Situation

Curves showing the employment situation, as published by the Employment Service of Canada, indicate that since April of this year, there has been a steady, though small improvement. The maximum was reached in July, 1920, following which there was a gradual increase in unemployment, very marked in the months of November and December, continuing to about the first of April. The index number for the two weeks ended September 24—the government's last report—stands higher than for any period since January 15 of this year.



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The laying of the corner stone of the Women's Christian Temperance Union's new Willard Hall, at Toronto, took place recently. Lady Flavelle officiatd at the ceremony, which was attended by a large gathering of friends of the W. C. T. U. A program of addresses by Hon. W. E. Raney, Rev. Peter Bryce, Rev. Dr. Chown, and others, followed by music and tea in old Willard Hall, completed the ceremony.

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## *The Fraser River Flood*

Engineering and construction efficiency in an emergency has been no better demonstrated than in the restoration of the means of communication and transportation in the area of British Columbia recently devastated by the flooding of the Fraser river and its tributaries. The sudden onslaught of waters, augmented in volume by unprecedented rains, swept away every obstacle in the path of the flow, washing out railway lines, collapsing heavy bridges and even destroying the Brittania Mines townsite, with a regrettable loss of 36 lives. Some idea of the extent to which engineering structures were damaged is given in the illustrations which accompany an article on the flood in this issue.

The interruption in the transcontinental railway service on both the Canadian Pacific and Canadian National lines was the most serious immediate result of the disaster and it was in the bridging of the gaps on these important arteries that such unusual speed and ingenuity was displayed. The fact that traffic was delayed for but five days is remarkable when it is realized that there were at least ten breaks on 150 miles of the C.P.R.'s tracks alone, necessitating over 4,000 feet of trestle to replace washed-out bridges and fills. The speed with which this restoration work was carried out is a splendid tribute to the organization and preparedness of the railway companies, who, on this occasion, as one official stated, experienced conditions, the like of which had never before been faced in the whole history of the railways. Had the maintenance departments not been prepared for urgent calls, it is very doubtful what progress would have been made in filling the gaps and restoring service.

Damage was not restricted, however, to the railways, for dams and pipe lines fell foul of the flood, leaving New Westminster and Coquitlam and some smaller towns without water supplies. This interruption of a vital utility demanded immediate attention and emergency measures were undertaken to serve the municipalities with domestic and industrial water until permanent works could be re-established. From reports it appears that there is a possibility of these systems being re-designed or re-located.

By this time, the damage, as far as public services are concerned, will be remedied, temporarily at least. The replacement of the destroyed structures by permanent ones will, of course, take time, but the fact that so short a tie-up was involved is creditable to the organization and preparedness of the companies and municipalities affected. The record of these achievements will always be a memorable one, fraught as it is with the stories of splendid accomplishments fulfilled in the midst of stupendous difficulties.

## *Road Work in Ontario to be Awarded Early*

At this time last year comment was made in these columns on the commendable action of the Ontario Department of Public Highways in calling for tenders on proposed road work early in the spring. The province has found that this course is redounding to its own benefit, for an examination of the road situation at the present time would indicate a considerably greater mileage completed than would have been possible had the awarding of contracts been deferred until the late spring or early summer. Contractors, too, are highly pleased with the way in which the provincial department has handled this phase of the highway problem, for they have been enabled to keep their organizations together for a longer period, and besides producing a greater output of road work,have carried it out on a more economical basis.

From plans already made by the highway department for next season's work, it appears that it will go even one step further and will award contracts even earlier than it did last year. In this issue we indicate the tentative plans of the department, outlining a scheme that will involve an expenditure of money amounting to millions of dollars. Complete specifications for the various contracts involved in that program will be available very shortly and contractors will then have an opportunity to investigate the conditions pertaining on the work on which they intend to bid, before winter closes in. It is expected that the department will provide sufficient opportunity for such investigation and examination on the part of contractors and that it will name a date for the receipt of tenders sufficiently early to permit the successful contractors to obtain supplies and gather their organizations before the winter breaks up. An early start will thus be assured and at the end of the season the department will have handed over to it, absolutely completed and ready for traffic, the entire mileage that was scheduled for construction.

### MUNICIPAL ASPHALT PLANTS IN CANADA

In Canada municipal asphalt plants are to be found at Brantford, Ont.; Charlottetown, P.E.I.; Chatham, Ont.; Hamilton, Ont.; Kingston, Ont.; London, Ont.; Montreal, P.Q. (4); Ottawa, Ont.; St. Catharines, Ont.; Sherbrooke, P.Q.; Toronto, Ont.; Victoria, B.C.; Winnipeg, Man., and Windsor, Ont.

*No. 71*

# *Canada's Engineers—P. A. Beique*

Mr. Paul A. Beique

**Mr. Paul A. Beique, consulting engineer, Montreal, whose biographical sketch appears herewith, was born in 1882 and is the son of Senator F. L. Beique, one of the directors of the Canadian Pacific Railway Company. He was educated at St. Mary's College, Montreal, and at St. Charles College, Baltimore, U.S.A., from which he graduated with the Bachelor of Arts degree. It was at the Ecole Polytechnique, Montreal, that he received his technical training, receiving from that institution the degree of Bachelor of Applied Science. Upon graduation, Mr. Beique spent some time on railway design and construction, as an assistant engineer and draughtsman. He then joined and remained for some years with the firm of O'Brien & Mullarkey, general contractors, with whom he was associated as superintendent of construction and general utility engineer. In 1909 he entered into partnership with Mr. Pierre Charton, forming the firm of Beique & Charlton, consulting engineers and land surveyors. Five years later this firm was dissolved, Mr. Beique continuing in the same line of professional activity. His present work includes all branches of municipal construction and general engineering, land surveying and legal questions and court work. His office is at 120 St. James St., Montreal.**

## GIVE EMPLOYMENT BY AWARDING ROAD CONTRACTS IN THE FALL

Herbert Hoover, U. S. Secretary of Commerce, has been urging the various authorities to award highway contracts in the fall in order to reap the many advantages that attach to such procedure. His arguments are summed up in the following letter sent to the governors of the various states:

"In making a systematic study as to what we can all do to promote employment and to thus assist in tiding over the very severe situation that we are now in, this department has had its attention called to the bearing of the period at which contracts are currently let for the building of public roads upon this problem. In order that there should be no question as to the correctness of the conclusions that had been reached, I summoned a committee comprising representatives of the great engineering societies who have prepared for me the enclosed opinion.

"The conclusions of this inquiry are, in a word, that there would be additional economy in construction if the contracts for the roads were let in the fall instead of in the winter and spring; that contracts let at this time would enable considerable employment over the winter in the manufacture of material and equipment and in the placing of material ready for construction early in the spring. It would enable contractors to give employment to some of their staffs through the winter instead of imposing it at a higher rate upon the short summer construction season. It would relieve pressure on labor during the period of larger demand for agricultural help and would, indeed, expedite the completion of road building.

"The criticism that we are in a period of falling prices and possibly of railroad rates, and that contracts let this fall might be at higher figures than would prove necessary later in the season may be answered by making provisional contracts so that any such difference would accrue to the state. This method has been partially adopted in a few states and you will, of course, understand that my only desire is to offer a suggestion that co-operative action might lead to some reduction of unemployment."

## DISPLAY OF ROAD MACHINERY AT GOOD ROADS SHOW

An exposition that will embrace $1,500,000 worth of labor-saving road machinery will comprise the coming thirteenth National Good Roads Show at the Coliseum, Chicago, Ill., January 17-20, 1922, to be held in conjunction with the twelfth American Good Roads Congress and nineteenth annual convention of the American Road Builders' Association. The exposition will demonstrate the marvellous growth that has characterized the road building industry in the past decade. At a drawing for space on Oct. 29 more than 95 per cent. of the 40,000 square feet of space available for exhibits was taken, necessitating the rental of additional buildings to accommodate exhibitors now applying for space. This great interest by manufacturers of road equipment surpasses that of any previous year and will make possible the exhibition on a greater and grander scale than ever before.

The program committee is now drawing up a strong program for the technical sessions of the Congress, and many road builders from all parts of the country will be asked to discuss matters of vital interest. Invitations will be extended to sixty U. S. states and territories and Canadian provinces, county commissioners and 3,000 mayors of American and Canadian cities to appoint from three to five delegates, and it is expected that by the selection of a comprehensive list of important subjects for discussion, the attendance this year will be greater than the record-breaking attendance of last year.

# Bridges, Railways, Towns Disappear in British Columbia Flood

## Extensive Area in the Fraser River Watershed Sustains Damage—Railway Companies Display Remarkable Efficiency in Restoring Service over Washed-out Structures—Water Supplies Cut off or Endangered

By the Pacific Coast editor of the Contract Record

Extending over an area roughly 150 miles inland from the Coast at Vancouver, B.C., and covering the drainage area of the Fraser valley for that distance, as well as the drainage area tributary to Howe Sound and Burrard Inlet, flood conditions were caused by unprecedentedly heavy rains during the last week of October. Even at this time the full extent of the damage and the probable cost of replacement and repairs can only be estimated. In the case of the Canadian Pacific Railway alone, the preliminary estimate given by the general manager of western lines, Chas. Murphy, places the cost to that company at a round million dollars. So serious were the losses to this company that Mr. Murphy made a special trip from Winnipeg to undertake a personal inspection of the company's lines which had been under such bombardment by the force of the elements. Every public utility in the lower mainland of British Columbia tributary to the Coast cities was more or less affected by the storm water precipitated in the brief period prior to Oct. 28th when the high water mark of the freshet, breaking through all barriers, carried away steel railway bridges weighing 300 tons, destroyed a mining town of more than 200 houses, with loss of thirty-six human lives, tore out steel water mains leading from great reservoirs in the mountains, interrupted power services, and spreading out over lowlying lands caused thousands of dollars of damage by flooding.

Possibly the most serious immediate result of the high waters was the temporary break in transcontinental railway service. Both the Canadian Pacific and Canadian National Railway main lines, leading to Vancouver, were tied up and traffic interrupted more or less for several days. The provincial government railway, the P.G.E., which reaches the coast at the head of Howe Sound, forty miles north of Vancouver, suffered so heavily from flood that the road went out of commission indefinitely.

### Restoring "Lines of Communication"

To meet the sudden emergency which broke the main line of the great transcontinental in a dozen places in the first 150 miles from the coast, the Canadian Pacific Railway showed more than organization, more than preparedness—resourcefulness and untiring energy to the greatest degree were displayed by the highest official down to the last man on the piledriver crews which were rushed to bridge the breaks. That they succeeded in fully restoring traffic in five days is a record in railway construction which will stand for a long time before it is beaten. A summary of the work accomplished in that time can give but a faint impression of the strenuous activities of that five day campaign, conducted under no ordinary railway construction condition. As one official said, in speaking of the havoc wrought by the mountain floods:

"In the whole history of the railway since construction, no such experience was ever before faced. Ordinarily the company is looking for severe weather up to November 15, marking the onset of winter conditions. Provision is always made well in advance for such expected conditions and in addition, the maintenance department is to a certain extent ready at all times for urgent calls."

First warning came early on the morning of Oct. 28th, when a message from Coquitlam, 20 miles from Vancouver, reported the river in freshet and a log jam threatening the bridge. A crew was at once ordered out with the bridge hoist equipment to tackle the removal of the logs, and a locomotive with a big steel cable was also put in commission. Such huge logs and trees came down with the flood that the jam rapidly increased and the water rose to the underside of the steel bridge. At 4.30 that evening the force of the flood undermined first the centre pier and then the west abutment. These went out and the flood swept the 300-ton steel structure to one side like a plaything. As the piers were concrete monolithic construction, the underscouring of the flood must have cut the ground to depth of 30 or 40 feet, for the two piers simply dropped out of sight, and no doubt lie buried under many feet of silt. The bridge was a 3-track steel structure of half-deck plate girder type.

The C. P. R. Coquitlam bridge, a 300 Ton steel structure, swept downstream by the Fraser river flood.

### Flood Overcomes All Resistance

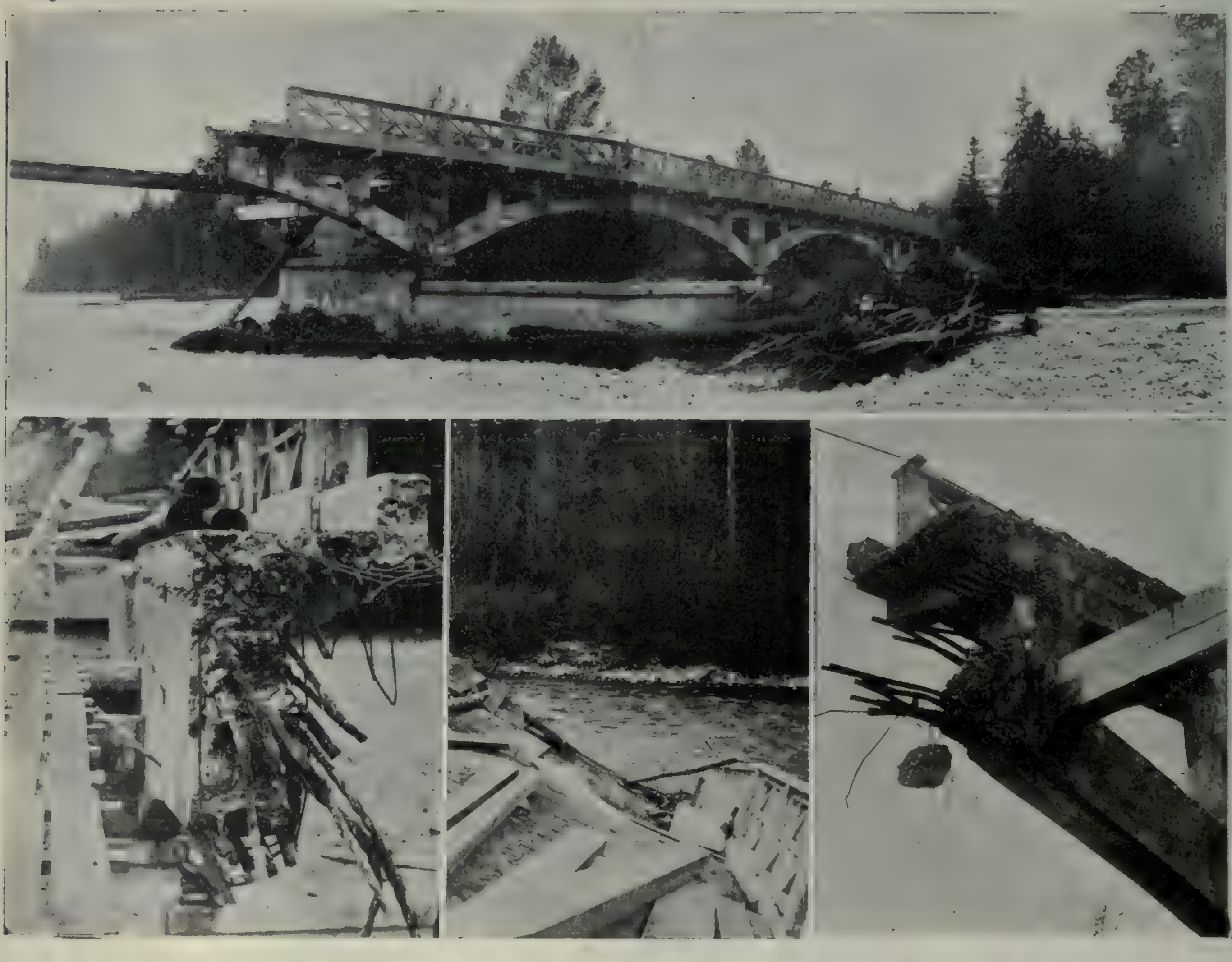
The force of the flood waters tore a new channel for the river a hundred yards west of the bridge and where the stream broke through it washed out five tracks of the main line and the Westminster branch, the junction of which is just west of the Coquitlam yards. The provincial highway bridge, just south of the railway bridge went next, the west abutment and half the bridge going down stream. At Westminster Junction the line was washed out for half a mile, while in the Coquitlam terminal yards adjacent, four miles of track were washed out. Trestles totalling 500 or 600 feet had to be built at these points to get the line open again for traffic. Before restoration is complete nearly 25,000 yards of material will require to be replaced.

At the very moment the engineering and bridge and building departments were rushing men, equipment and material to Coquitlam to effect repairs, urent reports began to pour in from a dozen points on the division as far east as Lytton. By the time the flood waters had subsided there were ten or twelve breaks in the C.P.R. main line on the Vancouver division in the first 150 miles from the coast. In the five days that elapsed before traffic was restored, 4000 feet of trestle had been built to fill the gaps. This was in addition to the work done at Coquitlam. Yale Creek bridge, a steel deck plate girder structure, stood up though half the west abutment went out. These abutments were masonry, and the water undermined them so that the bridge remained insecurely suspended. It was dangerous to attempt piledriving work, so a number of framed bents were erected under the steel and the bridge jacked up into place. At Quoyeek Creek near Kanaka, the eastern limit of the damage, a fill, 70 or 80 feet wide and 200 feet long, went out. It took 90-foot piles to drive the bents for the trestles put in at that point. East of North Bend another fill, 125 feet long and 40 or 50 feet deep, had to be bridged by a pile driving crew. China Bar was the location of another break, where a 165-foot fill 40 feet or more in depth had to be replaced by trestle. At 5-mile creek, east of Yale, a 100 foot trestle now replaces a fill 25 feet deep which went out. And so down the list, details might be given to show what had to be done that Canada's great railway system should maintain its traditions of uninterrupted service.

### Service Resumed Quickly

From as far east as Revelstoke, bridge and building crews were rushed west to assist the men of the coast division. They brought their own pile-driver while the big steel driver, which was working at Mission at the time the storm broke, was sent further up to rush work on a number of breaks, leaving Coquitlam and Westminster Junction to the smaller equipment units and to the assistance of such coast contracting firms

## *In the Wake of the Flood!*



Advance pictures from the Pacific coast specially taken for the Contract Record, illustrate the extent of the damage that was occasioned by the Fraser river flood of October 28 and 29. These cuts depict the bridge on the North Shore Marine Drive, Vancouver, after the waters had subsided. The whole structure is torn asunder while entire spans have disappeared.

as Armstrong & Morrison, T. R. Nixon Construction Co., and the Fraser River Pile-Driving Co., all of which rendered splendid aid in the emergency.

It was with quiet satisfaction that the officials and men of the company reached the successful culmination of their labors on November 2, when at 6.30 the track at Coquitlam was reported clear and trains were again despatched from Vancouver. Three hours later, at 9.30, the reports came in from all points up the line that the track was clear for traffic right through. Cisco, the eastern boundary of the trouble area, is the point where the C.P.R. and the C.N.R. cross the Fraser, the former to the south bank and the latter to the north bank. Lytton, a few miles further east, marks the beginning of the first of the interior "dry belts" and the confluence of the Fraser and Thompson rivers, the former coming from due north and the latter from the east.

To the men of the bridge and building crews and the personnel hurriedly gathered together for the work of restoration, the officials of the company pay high compliment for their loyalty and untiring efforts to get the work done in the shortest possible time. One of the features of the whole experience is that not a life was lost, nor a train, either passenger or freight, wrecked. This is the more remarkable when it is remembered that the numerous high fills on the right-of-way went out in many cases with no warning, having reached the point of saturation from the gathering flood waters behind them. For that proud record the C.P.R. credits the efficiency of their track inspection service. In many cases the track-walkers spotted impending danger and warned trains. A number of passenger trains were held for two or three days at points where washouts on either side cut them off, but in no case was serious inconvenience caused. And with all the thousands of cars of freight in transit no losses were sustained.

### Small Streams Became Raging Torrents

From definite reports it would appear that the flood conditions caused by the heavy rainfall covered the area on the north side of the Fraser River to Cisco, 147 miles from Vancouver by the C.P.R. main line and thence west to the Gulf of Georgia. The Fraser River from Cisco to Hope, 80 miles inland, runs almost due south. At Hope it turns sharply west and thence to the sea. The area enclosed in that huge rectangle from the Gulf of Georgia eastward is of mountainous nature, including many high peaks, and the valleys carry numerous large streams, all of which, except those draining into Howe Sound and Burrard Inlet, flow into the Fraser on its north bank. Principal of these are the Coquitlam, Pitt, Stave and Lillooet, all of them with a large drainage area in which are numerous lakes and many smaller tributary mountain streams. Further inland are such small streams as Yale Creek, Five Mile, and Quoyeek Creek, all draining directly into the Fraser and at ordinary times quite small streams. Under the sudden pressure of such heavy precipitation they become raging torrents in a few hours and until the freshet subsides they are beyond control. Into Howe Sound flows the Cheakamus River at Squamish, always an unruly stream at best of times and difficult of control owing to the wide spread of tidal flats at the head of the Sound. Britannia Creek also flows into Howe Sound, and on the south side of the range of mountains which divides Howe Sound from Burrard Inlet, three large streams, Capilano, Lynn and Seymour, flow into the Inlet. These are important as they furnish the domestic and industrial water supply for Vancouver City and all the adjacent suburban municipalities, including those on the north shore of the inlet. The Coquitlam, besides supplying domestic water to the cities of New Westminster and Coquitlam is one of the sources of power for the B.C. Electric Railway Company. On Stave River, thirty miles further inland, is the other big hydro-electric power installation which serves the industrial communities of the lower mainland and provides motive power for the city, inter-urban and rural electric railway lines of the B.C. Electric, one of the most extensive systems in Canada. Both of these power sources most fortunately escaped any serious damage, though some of the high tension transmission lines were temporarily down through freshet conditions.

### Water Main Wrecked

Coquitlam river which created such havoc for the C.P.R. at the same time wrecked some miles of the 25-inch steel water main which supplied the city of New Westminster and the city of Coquitlam. Though two weeks have elapsed the damage has not been repaired, even partially, but a temporary supply is shortly to be in commission from Silver Creek, a small tributary, which will serve till the main can be rebuilt to Coquitlam Dam. To understand the extent of the damage to this pipe line, which was some 12 or 14 miles long, one has to realize the character of the deep valley in which the river runs, and along the bank of which the line was laid. In many places there are sharp declivities to the river. In other places the valley broadens out and for that reason the Coquitlam is notorious for changing its course with every high water period. In places where the pipe line followed a high bank, the recent freshet tore away the supporting terrain, which carried the pipe with it. In flat stretches the river burst its banks and made a new channel, in several places cutting right along the course of the pipe line and tearing out the pipe.

Some idea of the volume of water suddenly precipitated into the channel of the Coquitlam may be gathered from the statement that at the Coquitlam Lake dam, the water went over the 250 foot spillway in a rushing torrent 9 feet mean depth. This is but one of a hundred mountain streams which were affected by the freshet. The Fraser itself, in the lower stretches rose 9 feet in a short time. That is less than half the high water mark of the June freshet, but the suddenness with which the hundred mountain tributaries poured their flood into the main river created a very different situation from the ordinary gradual rise.

Just how near the city of Vancouver and the Greater Vancouver suburban areas came to being without a water supply in the way that the City of New Westminster suddenly found itself on the evening of Oct. 28th, is a story that may be told when the engineering department of the city completes the task of restoring and rendering safe the protection work which was the mainstay of the city's water supply mains from Capilano and Seymour Rivers. Both these sources are mountain streams flowing into Burrard Inlet (Vancouver Harbor) on the north shore. Several large mains, some of them 36 inches in diameter, carry the supply from head-works situated some miles up from salt water. These mains connect with submerged mains under the Inlet which carry the water to two reservoirs at high points on the Greater Vancouver area. By great good fortune neither source nor supply mains were put out of commission, though the head-works house on Seymour Creek was almost buried by gravel wash carried down by the torrent.

From the connections which serve Burnaby municipality, water from the Seymour Creek mains was turned into the New Westminster city mains in limited supply, almost immediately, through one or two small distribution mains in Burnaby which were easily connected to complete the circulation. Meantime city engineer Fellowes had a large emergency crew of men organized and put on the work of repairing and protecting the Capilano and Seymour mains. This work, like all the restoration following the flood damage, is still under way and will occupy some months. North Vancouver city, which has an independent service from Lynn Creek experienced temporary difficulties from blocking of the intake works, but energetic measures to clear the intake soon restored the service to normal.

### Britannia Beach Disaster

Britannia Beach, the small mining town peopled by the employees of the Britannia Mining Company, was almost wiped out, with the regrettable loss of 36 lives, and the injury of many other residents. More than half the houses in the little town were wrecked and many of them swept into Howe Sound by the force of the flood waters of Britannia Creek. The burst occurred late in the evening and many of the unhappy people were in bed. So sudden was the onrush of waters that little or no chance of escape was afforded.

So far as at present ascertained this flood was caused by the waters of Britannia Creek being impounded behind a very high fill across the creek valley at an elevation of nearly 2,000 feet above sea level. This fill, on which a mine railway crossed the ravine, was completed a year ago. It was located just below the dam which furnished head for the mine's power line. It is stated by those appointed to investigate the matter that the culvert at the bottom of the fill, which was ample to take care of the run-off from the dam, became blocked and the water backed up till the deep fill reached saturation point, when it suddenly broke away, and a seventy-foot wall of water was hurled like an avalanche on the little town at the beach. This is the third disaster the mining company has sustained in a few years. A bad mine wreck was followed last year by the burning of the large concentrating mill.

# House Building and Unemployment

## Montreal Conference on Housing Conditions Will Ask the City Council to Take Action—Erection of Homes Considered to be a Satisfactory Way of Providing Work

Up to the present the city of Montreal has refused to take up the share of the Federal grant for building workmen's houses allotted to the city by the Quebec government, the administrative commissioners declining the grant on the ground that the Act was not workable in Montreal. A new council is now in power and it was decided at a meeting held in Freeman's Hotel on November 18 to make another attempt to get the civic authorities to take steps to put the Act into operation.

The meeting, presided over by Mr. F. Wright, was attended by representatives of several organizations. The chief speaker was the Rev. Father Hingston, who made an admirable analysis of the unemployment situation in relation to the building trade, arguing that the construction of workingmen's houses, aided by a subsidy, was the best method of solving the unemployment problem. Some of the speakers made strong complaints against the trade unions, while their attitude was as strenuously defended by others.

The chairman briefly reviewed the local housing situation, pointing out the acute shortage of houses. It was estimated that only 14 per cent. of the people of Montreal owned their own houses. He believed that the government scheme for constructing houses was feasible, provided that it was not tied down by unnecessary restrictions.

The Rev. Father Hingston remarked that in considering the unemployment question, three problems were involved—unemployment, lack of houses, and the idea of people obtaining their own homes. It was asserted by some that unemployment was inevitable, and should not be interfered with by artificial means; further, that the present position was a very bitter but good medicine for the workers, who insisted on exorbitant wages and shorter hours. The speaker pointed out that the housing question and unemployment formed part of the economic situation which extended over the civilized world. Father Hingston discussed several suggested methods for alleviating unemployment, and expressed the opinion that the construction of houses of the cheaper class would be the best means of relieving unemployment and at the same time solving the housing problem. It had been suggested that the building of roads and other public works would prove of value, but he pointed out that such a scheme, good as it was, meant increasing the public debt and consequently taxation—an objection which was absent in a building scheme. In his opinion it would be essential for government or civic financial aid, in the way of a loan, to be given to private persons who would build. At present building was retarded because there was a general belief that the cost of building supplies would be still further reduced, and therefore, it would be good policy to wait and obtain the advantage of this lower cost. His idea was for financial aid to be given to such an extent as to establish a margin of safety for those willing to build. He estimated that in Montreal $70,000 a day was lost owing to unemployment. If the Government could by means of a loan enable houses to be built and so relieve the situation it would be much better than the complete loss involved in giving doles, even if the cost was above normal. Such a scheme was economically sound. It would give employment to a very large number of people not only in actual construction but in the supply of necessary materials.

Mayor J. Beaubien, of Outremont, a member of the Metropolitan Commission, referred to correspondence with the provincial government in regard to aid for housing schemes. The answer had been received too late to start any plans in connection with the municipalities under the jurisdiction of the commission. Personally he doubted the wisdom of municipalities engaging in building operations having regard to previous experiments.

### Labor to Blame for the Situation

Mayor R. M. Ballantyne, of Montreal West, remarked that even if buildings were put up at a loss it would be better than giving doles which represented a complete loss to the community. Mr. Ballantyne asserted that wages in the building trade were too high and must be reduced. Besides that, there must be a reasonable day's work for a reasonable day's pay. In his opinion the men were largely to blame for the present situation.

Mayor Prieur, of Pointe-aux-Trembles, stated that his municipality had tried municipal building with more or less success. He attributed the housing difficulty to the high price of land in Montreal, and expressed the opinion that unless this is changed, it would lead to the growth of revolutionary ideas.

Dr. Atherton referred to the difficulties put in the way of solving the housing question by the Administrative Commission.

Mr. Lansing Lewis declared that the reason for the comparative lack of building was the high cost of labor. The trade unions were trying to keep up the standard of wages paid during the war, and in addition, the men did not always give a fair day's work.

Mr. H. A. Ross suggested that any housing scheme must, to be a success, be entrusted to private initiative, even if aided by the Government. He believed that the contractor should reduce his profit and the workman give the best that was in him.

Mr. A. Smith stated that the best way to revive the building of houses was to exempt all improvements for a period of ten years.

Replying to Mr. L. Lewis, Father Hingston stated that the question of high wages was only part of a vicious circle. The fault was not all on one side. He believed that the circle could be broken by means of government aid for constructing houses.

Mr. F. T. Jones, president of the Canada Cement Co., declared that he had heard a number of complaints concerning the working man, but there were faults on both sides. The most serious factors in the industrial situation were rail and coal costs.

### Labor's Attitude Defended

Mr. R. Lynch, as the representative of labor, strongly protested against the attacks on the working people. He asserted that the salaries of the executives of large concerns were not being reduced, and there was no reason why wages should be cut. It was to the interest of the working people that housing conditions should be improved and further building carried out, and he was sure the unions would do their part in making any scheme a success.

Mr. A. Drinkwater, city engineer of St. Lambert, described what is being done there in connection with the housing grant from the provincial government. There were, he said, no difficulties in carrying out the Act, which in no way interfered with private enterprise. The municipality did not engage in construction work, it saw that the money was paid and the building by-laws observed. A loan of $700,000 would have been spent in 18 months. The money was loaned to individuals and to building companies. Within 13 months, 130 dwellings were erected or in course of erection; 33 houses were erected by individuals and the balance by seven housing companies.

Mr. Kobach explained a scheme now in operation in Montreal for building standardized houses by which the construction and financing costs were reduced. There were, he stated, several hundred applications for houses to be built. The Anglin-Norcross Company were the contractors for the houses.

Mr. Adlington stated that it was proposed to carry out a scheme for building workmen's houses in Model City.

With the view to securing practical results, it was decided that the chairman should nominate a small committee, the members of which will wait upon the mayor and city council, in order to obtain action in the direction of the city taking up the federal grant for housing purposes, or in some other way putting into operation a scheme for the construction of workmen's dwellings.

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## CONSTRUCTION CONFERENCE, HAMILTON, JANUARY 17-20

The fourth annual conference of the Association of Canadian Building and Construction Industries is to be held in the city of Hamilton, Ont., on January 17 to 20. The sessions will be held in the ball room of the Royal Connaught Hotel. At present it is impossible to give complete details of the programme; however, the intention is not only to have discussions of the various vital questions which have arisen in the construction industry during the past year, but also to include some features of an educational nature which will be of utmost interest to members of the different sections.

In regard to the conference, Mr. J. C. Reilly, secretary of the Association, writes: "We are also planning an interesting departure at this conference in apportioning space around the sides and back of the conference hall to our manufacturing and supply members for exhibition purposes. This feature of the convention will be in charge of Mr. E. B. Osborne, the secretary of the Hamilton Association, and entry should be made with him at the earliest possible date.

"The daily luncheons, which have been such an enjoyable feature of our previous conferences, will again give an opportunity for some of the leading men of Hamilton to address the visitors to their city. Other social features are also being arranged.

"We feel that the present conditions in our industry, and the possibility of an early revival of construction in Canada should mean a large attendance and great interest in the sessions."

In regard to the proposed exhibition, Mr. Reilly writes further: "Exhibits would have to be of such a nature as could be accommodated in this room and provision would have to be made to prevent defacing walls, etc. It is suggested also that a representative from the firm exhibiting should be in charge and at some stated time during the conference proceedings should explain the products of the firm to the delegates."

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## AGENT APPOINTED

The Orton & Steinbrenner Co. of Chicago, manufacturing locomotive cranes, also shell and orange peel buckets, have made arrangements with the F. C. Richmond Machinery Co., 117 West Second St., Salt Lake City, Utah, to represent them.

# South Shore Highway from Montreal to Quebec

## Large Gathering Urges the Province to Build New Road—S. L. Squire Enunciates Road Principles

The intense interest taken by the people of the province of Quebec in the good roads movement was demonstrated at a convention called together at Sorel, P.Q., on Tuesday, November 15th, by the Chambre de Commerce of that town, and attended by 300 representatives of municipalities situated in that part of the province lying south of the St. Lawrence River. Among those present were Mr. Joseph Beaubien, president of the Quebec province section of the Union of Canadian Municipalities; its secretary, Mayor Prieur, of Pointe aux Trembles; Hon. J. L. Perron, Quebec's new minister of highways, and Mr. S. L. Squire, of Toronto, chairman of the executive of the Canadian Good Roads Association, the two last-named being the principal speakers of the day. The object of the gathering was the forwarding of the movement to duplicate, along the south bank of the St. Lawrence, the splendid highway 180 miles in length, which links Montreal with Quebec. The projected south shore road would have its terminals at St. Lanbert, at the southern end of Victoria bridge, and Levis, opposite Quebec. Of its approximately 180 miles, about one-half now consists of improved road surface, but there are many stretches of primitive road.

### Should Practice Economy

While Mr. Squire's address dealt particularly with Quebec's highway progress, his remarks had a wide general application. It was no part of the policy of the Canadian Good Roads Association, he said, to dictate or even suggest to any province what highways it should or should not build, but there were certain broad principles which the association commended to provincial authorities everywhere, and one of them, which he thought applicable to the project under consideration, was the unwisdom of allowing isolated stretches of good road to remain without linking them up so as to provide continuous highways connecting important centres. Going on to enunciate other guiding principles for road builders, Mr. Squire advocated the practicing of the strictest economy consistent with the provision of roads suitable for present-day traffic needs and allowing for the increased immediate use arising out of the improvement and out of anticipated developments. Costly and ornate boulevards through the country might come later, but the demand of the present was primarily for highways of a permanent surface, with minimum curves and gradients.

A province, said Mr. Squire, should treat its highways as a productive investment, capable of returning substantial dividends to all classes of the people. Quebec, he pointed out, had approximately 40,000 miles of roads, their right-of-way occupying about 320,000 acres, which at the moderate estimate of $50 per acre represented a land value alone of $16,000,000. On these roads, prior to 1912, about $40,000,000 in money and labor had been expended, and since 1912, when the Quebec Government adopted its progressive road policy, $32,000,000 more had been spent. Quebec's investment in roads, therefore, represented almost $80,000,000, and this heavy investment merited protection by an adequate system of maintenance. In this connection he suggested as a model the Wisconsin patrol system, by which the state's roads are divided into 1,200 sections, with an average length of eight miles of road to each patrol. Under this system, Wisconsin's secondary roads of crushed stone and gravel, are maintained at an average cost of $175 per mile per annum. A good gravel road, well maintained, said Mr. Squire in passing, would give better service than the best macadam road, if neglected and allowed to deteriorate.

### Roads Fundamental to National Development

Road improvement to the limit justified by revenues and resources was sound provincial policy, Mr. Squire claimed, because roads were fundamental to the development of a province or a nation. The difference between savagery and civilization was largely a matter of the development of means of communication, of which roads were the earliest and still a most important example.

Some of the other speakers having expressed a fear that no further payments would be forthcoming from the Dominion Government's $20,000,000 fund for highway aid, Mr. Squire declared that good faith required a continuation of the payments, and he was confident that no matter what party might be in power after December 6th, the agreements between the Dominion government and the provinces would not be treated by the former as mere scraps of paper.

After representative delegates from the various municipalities had urged the claims of the south shore highway, Hon. Mr. Perron, in a brief address, promised that the government's most friendly consideration would be given it early in the new year. It was stated by some of the speakers that they represented municipalities having a combined population of 250,000, which would be served by the proposed highway.

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# Initiate Public Works to Solve Unemployment

## Associated Boards of Trade also Deplore Canada's Fire Waste and Support St. Lawrence Shipway Scheme

As a solution for the unemployment problem, the Associated Boards of Trade of Ontario, which held their eighth annual convention at Brantford, Ont., recently, will suggest to the Dominion Government the working out of some big national scheme, to be shared by all the provinces, cities and towns and municipalities interested, by which industrial activities would be reopened and public works would be undertaken, with a view to spreading the work over the Dominion evenly, in such a manner that the greatest amount of employment would be given in those localities where the unemployment problem is the most severe. At the same time, the members of the fifty-six Boards of Trade went on record as being opposed to the dole system of handing out charity. It was felt that some systematized method of investigation should be carried out.

### Fire Prevention

The question of fire prevention came in for a great deal of discussion, the cause being championed by Messrs. D. A. Cameron, Arthur Hewitt and W. H. Shapley, of Toronto. As Mr. Cameron outlined the situation, the fire loss in Canada, apart from forest fires, has reached such financial proportions that it was now the duty of the Ontario Government to instruct the fire marshal's department to look at things in a different light. At present, it was claimed, the fire marshal appeared to think that his duties lay along the direction of investigating fires, whereas the Boards of Trade believed that a great deal more could be accomplished if the same time and money were spent in fire protection.

In supporting this attitude, Mr. Shapley pointed out that with proper preventative measures some $10,000,000 could be saved yearly. The Hydro, he remarked, went to an investment of $100,000,000 to save $6,000,000 yearly, and yet the government is doing practically nothing to save that $10,000,000.

### Deep Waterways Project

Apart from immediate Board of Trade activities, the convention took time to show their sympathy for the activities of the Deep Waterways and Power Association, as, after hearing the appeals of O. E. Fleming, K.C., of Windsor, president, and Alex. Lewis, secretary, of the organization, they passed a resolution extending to the movement their fullest endorsation.

In making his appeal on behalf of the Deep Waterways Association, Mr. Fleming declared that something should be done to counteract the effects of Montreal's attitude, and the recent resolution of that city, which put them on record as opposing the scheme. As Mr. Fleming viewed it, Montreal is trying to create the impression that the New England states and all of Quebec are against it, while he assured the convention that they now have six New England states solidly behind the movement, and that Montreal is the only part of Quebec which is standing out.

# Exhibition of Building Supplies and Materials

## Construction Industry of Montreal Behind Scheme for a Large Display and Demonstration

An exhibition of builders' supplies in the spring of next year was the project which was put forward and discussed at a recent meeting held under the auspices of the Montreal Builders' Exchange although it was stated by the president, Mr. K. D. Church, that it was not the intention of that organization to assume responsibility for the scheme if it were launched. The meeting was composed of members of the Exchange, together with one or two outside but associated interests. Interest in the matter was sufficient to lead to the formation of a committee which is to approach parties likely to be attracted by the proposition. It was suggested that the exhibition, if it were carried into effect, should be essentially Canadian, but this idea did not find favor, as it was pointed out that one desire was to attract the interest of American contractors.

Mr. K. D. Church, who presided at the meeting, explained that there had been considerable sentiment that there ought to be some sort of building demonstration in the building trades industry, and that a letter had been received from a member of a firm which had put the proposal in tangible form.

This letter from Mr. K. C. H. Monks, C.E., of Monks, Manhard & Dawson, engineers of Montreal, was then read by the secretary-treasurer, Mr. David Trotter. In this the writer pointed out the need for a public demonstration in the nature of a building trades exhibition. He stated that through daily contact with architects, engineers, contractors and owners, he had been constantly impressed with the lack of information of, and familiarity with, the various materials available and methods as to their employment. There was a constant flow of materials new to Montreal, some well proven, others of doubtful value, which were finding a place in various structures, occasionally resulting in disastrous experiments which were costly to the owner and damaging to the reputation of architect and contractor.

Mr. Monks added a few verbal explanations, urging that it would be educative to architects, some of whom hesitated to use new materials and inventions of which they had little or no knowledge.

### Approval of Scheme

Some discussion as to the date of the proposed exhibition and of other points took place, and a resolution was moved by Mr. W. E. Ramsay to the following effect: "Considering the fact that this exhibition will be held under the auspices of the Builders' Exchange, resolved, that the secretary be instructed to issue circular letters to all parties likely to be interested in the city of Montreal, soliciting their support, either by contributing or by subscription for space." This was seconded by Mr. K. C. H. Monks.

A proposal was made by one member that the exhibits should be 100 per cent. Canadian; but it was pointed out that there were some useful building materials peculiar to England and the United States that should be admissible; also that the contractors wished to see American visitors coming to Montreal. The chairman suggested that this point could be held over, as the main thing to do was to decide on the exhibition.

Mr. R. H. MacDonald, of Ross & MacDonald, speaking as an architect, told of difficulties frequently experienced by his profession in the selection of materials, and generally approved the project.

The motion authorizing the preliminary steps was carried, and the question of responsiblity was then raised; but the chairman held that the Builders' Exchange could not assume this. It must be upon those who were more particularly interested in builders' supplies. Ultimately a committee consisting of W. E. Ramsay, J. E. Benoit, J. Anderson and K. C. H. Monks was appointed to sound those likely to be interested and to report back.

### 3,690 MILES OF ASPHALT STREET PAVING LAID IN U. S. THIS YEAR

That American cities are making tremendous strides in street paving is indicated in records from city engineers to the Asphalt Association, New York, which show that thirty million square yards, or 1,750 miles of asphaltic pavement, thirty feet wide, will be laid on city streets this year. Reports from state highway departments indicate that 23,000,000 square yards will be laid on the state highways, while the area laid in counties and other districts will bring the total to 65,000,000 square yards, or 3,690 miles of asphalt pavements 30 feet wide. This will be an increase of 35 per cent. over the yardage in 1920, and is sufficient to build an asphalt road thirty feet wide from Augusta, Me., to San Francisco, Cal., and then some.

# Manufacture of Cast Iron Pipe by Centrifugal Methods

## Description of the DeLavaud Process and Machinery—Comparison of the Centrifugal Product with the Sand Cast Pipe

By F. W. Hudson, M. A. S. M. E., Assistant to the President, National Iron Corporation, before the Toronto Branch, E. I. C.

One of the most recent inventions of interest to municipal engineers is that of Sensaud de Lavaud, a French engineer, who, by utilizing centrifugal force, has perfected a machine which can be continually operated to cast melted material into tubing, and is now being used in several countries for the manufacture of cast iron pipe suitable as a carrier of either liquid or gas under high pressure.

The machine for producing cast iron pipe is ingenious in design, consisting of a rigid bed, which is slightly inclined from the horizontal, and on which at one end is mounted a stationary frame for supporting a tilting ladle and trough, through which runs the molten iron to the interior of the revolving mold. The casing containing the mold is mounted on wheels and is connected to a hydraulic cylinder, which imparts endwise motion.

The revolving mold is water cooled and has an impulse water wheel attached at one end and is supported by two sets of rollers, which are carried on the inside of the casing. The bell end of the mold is extended to act as a guide for exact centering of the core which forms the lead groove.

All motions of the machine are hydraulically operated and the operator, without leaving his platform, has perfect control of the tilting ladle, speed of mold, endwise travel of casing, cooling water around mould and trough.

The tilting ladle supplies iron for the bell end first, but almost simultaneously with the first iron running from the end spout of the trough a uniform motion endwise, or away from trough, is imparted to the casing and mould which allows the molten iron to be evenly deposited on the interior of the fast revolving mould for the entire length.

The mould being water cooled causes very rapid cooling of the pipe, also contraction, which allows the pipe to be quickly removed and the core inserted in the mould for the next pipe, a complete cycle in the operations requiring approximately four minutes.

After the pipe is removed from the mould it is placed in a special oil-fired furnace in which it is continuously revolved, ensuring uniform heat treatment from end to end of pipe. This completely removes the slight chill about 1/32 in. deep caused by water cooled mould, and leaves the metal of a homogeneous texture, which can be easily cut or machined. After cooling sufficiently the pipe is dipped in a tar preparation and then tested and inspected, the test being 300 to 2,000 pounds per square inch hydrostatic pressure according to customer's requirements.

A comparison of the tensile strength between sand cast and machine cast pipe shows very interesting results:

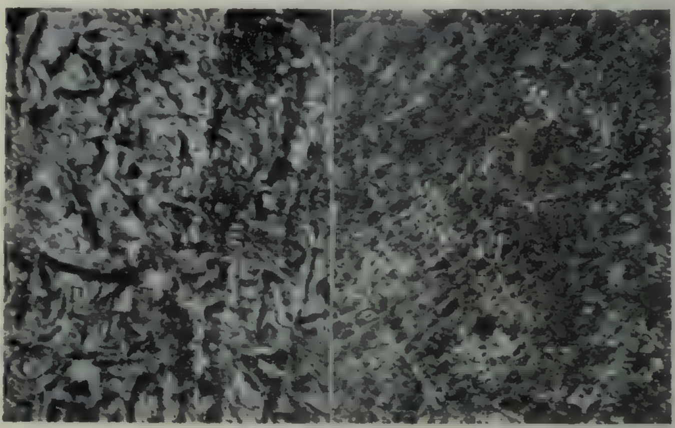
From the same ladle of molten iron two six-inch pipes were cast, one being cast by the sand method and the other in pipe machine, with the following results:

### Analysis of Metal in Pipes

Analysis of metal in pipes

| | Sand Cast | Machine Cast |
|---|---|---|
| Silicon | 2.59 | 2.62 |
| Sulphur | .066 | .058 |
| Phosphorus | .558 | .556 |
| Manganese | .65 | .63 |
| Comb. Carbon | .44 | trace |
| Graphitic Carbon | 2.91 | 3.30 |

Machined test bars from the two pipe showed the tensile strength of sand cast at 16,500 lbs. and machine cast at 34,900 lbs. per square inch. The sand cast pipe at opposite sides was 7/16 in. and 9/16 in. thick, while the machine cast pipe showed an even thickness of ⅜ in. Both were tested to destruction in hydraulic press; sand cast pipe broke at 1,200 pounds and machine cast at 2,500 pounds pressure. The results of tests show that the tensile strength of machine cast pipe is more than double that of sand pipe.



The structure of the metal in sand cast pipe (left) and in centrifugally cast pipe (right). Magnification 100 times.

The old method of casting pipe in sand molds with sand cores frequently produces thin-sided pipe, which are not always desirable to the inspector; also, the pipe are subject to blow holes, sponginess and shrinkage defects, all of which are eliminated in machine cast pipe, which, due to high revolving speed of mold when the iron is in a molten state, causes it to be so distributed that the outer and inner surfaces of the pipe are perfectly concentric and being subject to centrifugal force it is compressed before and during solidification.

The tapping of machine pipe for service connections is very satisfactory owing to the toughness of the metal and certainly that thickness is not subject to variation.

The non-corrosive properties of this pipe are described by Prof. Gillespie, of Toronto University, whose report reads in part as follows:—"The very homogeneous structure characteristic of de Lavaud metal would indicate that pipe made therefrom will possess high capacity to resist corrosion, especially in underground service." The many accelerated acid tests made on this product substantiate the theory of Prof. Gillespie.

Pipe made under this process is coming into general use throughout the world. The Stanton Ironworks, of Nottingham, England, control the patents for Europe and the British Empire, except Canada, and the United States Cast Iron Pipe & Foundry Company the patents for the United States—these are the two largest manufacturers of cast iron pipe in the world. The National Iron Corporation, of Toronto, owners of the Canadian patents, have been meeting with great success in marketing the pipe in this country and are now increasing their facilities to take care of the constantly increasing demand.

# Can the Cost of Highways be Reduced?

## The Highway Division of the Associated General Contractors of America Have Drawn up a Report Indicating the Factors, Exclusive of Direct Construction Charges, Which Increase the Cost of Hard Surfaced Roads

To build a system of hard surface roads that will carry the country's expanding rural and interurban traffic may entail a prohibitive financial burden unless present construction costs are reduced. The investment in improved highways at the present is held by many persons to be economically unsound, and doubt has been expressed as to whether the taxpayers would continue to vote for bond issues unless a greater mileage were obtained by their appropriations. To bring about lower construction costs is obviously a matter of vital concern to highway departments, and it is also an important matter to construction companies, who will profit by an increased volume of work. Through united action by these two parties, the necessary reductions can doubtless be brought about.

It is generally sensed that we are about to emerge from the much-discussed period of deflation and readjustment, and, at this time, the outlook indicates that many unit costs which were once well established have been so disarranged that they cannot return to their former level through deflation alone. A number of reasons for this situation are readily discerned: Labor scales in the basic industries producing gravel, cement, asphalt and other materials may, with labor strongly organized, remain high for some time to come. Certain material sources have been depleted and production at other sources is more expensive. Moreover, the action of governmental agencies in passing laws and increasing transportation rates has added expense to construction which is entirely independent of deflation. These things have brought about a new economic situation and therefore a different set of unit construction costs.

### Improve Methods and Cut Overhead

Present costs may undergo some additional deflation, and the gradual trend of labor and materials throughout the coming period may effect a decrease; but, to bring about the substantial reduction needed in the near future, it will be necessary to improve construction methods and to cut down the so-called indirect or overhead expense. Many of these expenses came into existence through causes which are now either insignficant or removed, and they owe their continued presence merely to the lack of co-operation on the part of engineers and contractors.

Numerous items of expense have crept into highway work by creating unnecessary obligations and requiring over-rigid guarantees. They have increased both the direct cost of production and the contingent costs, and it is in these two fields that highway departments and contractors can most advantageously co-operate. The department can assume certain obligations more economically than the contractors and can remove certain contractual provisions which add unnecessary expense to a contract. The contractor can then eliminate these uncertain items from his estimate and can improve the efficiency of his methods. When this is accomplished he can submit a materially lower bid. To designate some of these expenses and to suggest the means whereby they can be reduced or eliminated is the object of this analysis.

### Possible Cost Reductions

Items of road building cost which may be reduced by joint action of highway departments and construction companies depends upon certain contracting practices. These practices fall naturally under the following heads:

1. Receiving bids and awarding contracts.
2. Administering contracts.
3. Principles of contracts and specifications.
4. Matters of legislation.

The various expenses arising under these four divisions are discussed from the viewpoint of contractors who have been building roads extensively during the past two years.

### I. Receiving Bids and Awarding Contracts

Before highway construction developed into its present gigantic proportions, contracts were but a matter of labor, materials and a small amount of overhead. Materials were usually supplied locally and transportation did not constitute a problem of any moment. Now, however, the situation is different. Road builders must compete with other industries in obtaining materials, labor and transportation, and to produce economically they must conduct their operations with an eye to the activities of those industries. This means that they must plan far ahead, and obtain sufficient work to introduce the economies of quantity production.

The crux of economical road building is a full season's work with as little moving as possible, but this condition cannot exist if highway contracts are split into small or isolated sections. It is necessary that each outfit be placed, wherever possible, on a section large enough to furnish a season's work. Otherwise several items of needless expense arise. These expenses are as follows:

(a) Loss of striaght time salaries and production time consumed in moving from one project to another and in organizing each new project.

(b) Extra freight charges and loss of production time through delay of the carriers.

(c) Extra cost of setting up and dismantling the plant between projects.

When work is awarded in short sections on which a well-equipped plant cannot be used advantageously, contractors cannot invest in modern, efficient plants. Unless they do purchase and operate such equipment there is scarcely a possibility of securing the economy of quantity output.

### Full Season's Work on One Job

By awarding contracts in lengths great enough to provide a full season's work for a modern plant, a better utilization of the construction season is possible, and the items enumerated may be held to reasonable proportions. Even further economies of this nature are possible when contracts are awarded well in advance of the actual construction season. In fact, the time of awarding is now regarded as one of the most important factors in reducing highway costs.

It is almost universally recognized that contracts should be awarded in the fall or early winter, thus enabling construction companies to do much of their preliminary work in the off season and to utilize concrete-pouring weather for increasing their pavement output.

Fall letting is a practice in which many engineers and contractors see promise of great economy, and a general increase in the efficiency of road building is expected through its adoption. This increase of efficiency and a correspouding decrease in cost are made possible by the following:

(a) A nucleus of well-trained men retained over winter to serve as a skeleton for the new organization.

(b) Elimination of dead time for permanent field organization by employing them on preliminary winter work.

(c) Elimination of one shipment of the plant, which is moved direct from the old work to the new without going into the contractor's storage yard.

(d) Adequate time for investigating and planning.

(e) Better transportation service during early months of the season, with possibly preferential freight rates at that time.

(f) Lower costs in the basic industries on account of a longer production season.

The total influence of fall letting affects so many factors in highway work that it is difficult to foretell what reduction of cost it would bring about, but contractors have estimated that the total cost of highway project could thereby be reduced five or ten per cent.

### II. Administering Contracts

The field experience of contractors has shown that most dissensions which arise between representatives of the highway departments and representatives of the contracting companies are due to an honest misunderstanding. Unless the cause of these misunderstandings is removed by exchange of views and discussion, they sometimes develop into cankerous enmity which interferes with proper execution of the work. Some means of providing such exchange is needed.

To encourage a mutual understanding of each other's problems in Iowa, a school for engineers, inspectors, superintendents and foremen was established prior to the beginning of new work. It served to acquaint each party with the difficulties encountered by the other and thus laid the groundwork for more satisfactory relations between the departments and its contractors. In the Iowa school the engineers and contractors evolve plans for executing the work, or if such plans have already been determined they see that all parties understand the plan and encourage suggestions for improvements. They also explain many of the questions which may be expected to arise from the details of any project and confer on other matters of mutual interest or benefit. This school, it was found, practically removed the element of personal friction and misunderstanding, and undoubtedly resulted in economy. Similar schools will probably result in more satisfactory contract performance if adopted in other sections of the country.

Another step towards removing many difficulties which arise in the field, and one which has already proved valuable, is the establishment of local conferences between engineers and contractors. These conferences would investigate local conditoins which affect the work, determine economical methods for doing unusual work, or arrange to take advantage of unusual conditions in the locality with the object of economizing on the work. Such conferences conduct discussions that lead to better economies in road building and consequently to lower construction costs.

### III. Principles of Contracts and Specifications

Contracts and specifications have frequently been regarded as delicate grounds in discussions between engineers and contractors, but it is nevertheless well understood that requirements commonly included in these documents cause unnecessary expense to the province. The province obviously needs certain protection and certain guarantees, but as the scope of these is increased it adds an element of uncertainty to the cost against which no construction company dare fail to provide insurance. This insurance, whether placed with an insurance company or carried as a contingent expense, increases the cost of roads. Insurance of this nature can often be carried more economically by the province, and if so carried would make possibl a reduction in the cost of surety bonds.

### Limit Risks to Contractors

If the risks against which construction companies are required to furnish protection were limited to those things over which the companies can exercise some measure of control, and if they were not required to assume responsibility for damage from practically every cause, they could eliminate from their estimates a number of contingent expenses. Some of the contingencies occur so rarely that the cost of insuring against them can be more economically assumed directly by the government. The infrequent occurrence of a contingency, however, will not justify a construction company in failing to provide insurance. One occurrence of some of these contingencies is sufficient to bankrupt a construction company and the company must, therefore, protect itself financially. This the bonding company also does in establishing its rate. By eliminating from specifications those hazards and responsibilities which can be more economically assumed directly by the province, a lower rate on surety bonds can doubtless be obtained.

### Irresponsible Bidders Raise Costs

Bonding companies say that the rate could be further reduced if the government would exercise a more comprehensive interpretation of the term "responsible bidder." The ability to furnish bond is inadequate proof of responsibility, because irresponsible bidders do obtain both highway contracts and bonds, and their failures raise the bond rate. If the highway department were careful to secure bidders who are actually responsible the rate could not only be reduced, but a reduction of bond could be made as sections of the work were completed and accepted. The savings thus made would reflect directly in the construction estimate. They would also reduce the total amount of money required to finance the work and hence the interest charges.

### Reduction of Interest Charges

Interest charges can also be reduced by the following procedure:

(a) Limit the percentage obtained by the province to an amount which experience has shown to be necessary.

(b) Limit the money retained to that amount held when the work is fifty or sixty per cent. complete.

(c) Provide for a specific date and method of payment upon which the construction company may depend —thus eliminating the expense of emergency financing.

(d) Return certified cheques and make awards promptly so that bidders receiving no award may look immediately for other work.

### Classification of Excavation

Among the uncertain factors which prevent accurate estimating is the matter of classifying excavation. A lack of accurate classification in excavation always introduces an uncertainty which will not allow an estimator to get down to the bottom price. He cannot risk striking hard material with an earth price and if, for example, hard pan or a stiff gumbo is anticipated and but a single or two-grade classification is provided, the price must obviously cover the cost of such material. If, however, a classification is provided which segregates the various grades of material, a construction company can safely bid its lowest price on each.

Similar to the lack of classification is the practice of lumping different kinds of work under a single unit price. In all such cases an uncertain cost is introduced which does not permit the lowest unit prices. The remedy is obviously to separate into units those items which vary in cost and can be determined separately.

### Overhaul Introduces Uncertainty

Still another uncertainty is caused by payment for overhaul. If a construction company is obliged to work under a pre-determined overhaul price, it knows that under many conditions the price will not cover the expense, and this contingency must also be provided for, if the work is to be performed at a profit.

Likewise, the contract provision governing changes in the work usually creates a dangerous contingency. This provision allows one department to increase or decrease the work without making any adjustment in price for the resulting change in cost. Every quantity eliminated carries with it a certain portion of overhead which stands as a loss and, unless the construction company is assured the work will go practically as planned, it cannot estimate with any degree of accuracy. The consequence is another item of insurance.

A common practice in estimating, and one which finds favor with state highway departments, is to place all items of cost, or a proportionate part of them, where they properly belong. This cannot always be done if the so-designated "percentage of profit on force account" is based only on direct labor and materials. The usual percentage allowed is the same as that adopted years ago, yet any engineer knows that the proportion of direct labor has decreased while the indirect expense, such as equipment, has increased. The usual percentage does not always cover the cost. This the construction estimator knows and must take care of it in some other place. Such misplaced cost may in the end bemore expensive for the province. A better plan is to account the work so that such expense can be definitely determined and settled. For this the contract can readily provide.

One other saving which the contract may bring about is that of inspecting materials at their source. Rejecting faulty aggregates after they have been unloaded precludes the construction company from recovering their cost. Inspection at the source would eliminate the waste of materials rejected on the work. This item of expense, like various others here cited, under "Contracts and Specifications," is of the indeterminate type and it is not possible to say definitely what economy it will bring about, but every construction company knows that, if these suggested changes were instituted, it could and would submit lower bids.

### IV. Legislation

Highway engineers and contractors have frequently agreed upon procedure which ought to be followed in building roads and which would bring about lower costs, yet the department is prevented from acting on account of existing laws. Legislation frequently interferes with proper functioning of the highway department in matters of which the department is best able to judge. It is to the interest of both department and construction companies to secure a repeal of such legislation and to work for the enactment of constructive laws which will develop proper highway systems.

Several specific changes in contracting practices, which contribute to more economical work, can be brought about by revising certain highway legislation. The changes are:

(a) An improvement in the form and character of road securities, which would facilitate their sale, reduce the market discount, and prove a saving to the province.

(b) A repeal of laws which prohibit payment for materials delivered. This would reduce financing charges and permit adequate storage of material.

(c) Delegation of police power to the highway department's representatives. This would enable them to regulate freely all traffic over roads under construction and would enable better planning of plant layouts and avoid much interruption of work.

Discussion of the four classifications of cost reductions which are possible in highway work is based upon the experience of road builders during the last two years.

The discussion of cost reduction as developed in this analysis is based upon the experience of construction companies which have been the pioneers in high type road construction. It therefore naturally portrays the situation from the contractors' point of view and may not recognize the necessity of certain practices as they exist. For this reason a similar analysis should be made from the viewpoint of highway departments. Two such studies would then show the actual possibilities of cost reduction and would produce a satisfactory basis for action. Once having agreed upon the proper course, engineers and contractors could undoubtedly bring about lower highway costs.

# Highway Program in Ontario for 1922

About seventy-five miles of permanent pavement will be laid by the Ontario Department of Highways, according to plans given tentative approval. This list, upon which tenders will be called early in the spring, is not final, as it stands, but it represents substantially the work of the government has in view, and forecasts an expenditure of at least $4,500,000. The sections of the provincial system chosen for next season's work include 39.95 miles of concrete pavement, 25¼ miles of asphaltic concrete and 12.65 miles of bituminous penetration.

In addition, the plans call for nine miles of macadam roadway, 43.8 miles of macadam base course, 43¾ miles of earthwork and rockwork and a considerable amount of other construction, including the Cooksville subway, the Bloor Street east subway, Binkley's subway, the filling in of the northerly two spans of the Belleville-Prince Edward Bridge, 1,000 culverts and 300 miles of grading.

The Department has not yet completed its plans for gravel surfacing, which will be carried on extensively during the season, largely by day labor.

### Roads To Be Improved

The roads to be improved, the type of work and the mileage are as follows:

Concrete pavement—G.T.R. crossing at West Hill, westerly, 3½ miles; Yonge Street, from Mausoleum northerly (alternative tender), 5 miles; Bloor Street, from Cemetery west to Dundas Street, from Cemetery west to Dundas Street, 2 miles; Main Street, from easterly limit of City of Hamilton easterly to junction with Stoney Creek Road stone stock piled at Stoney Creek Station, G. T. Ry.), 4 miles; St. Catharines easterly to Welland Ship Canal, 3¼ miles; Kitchener to Freeport, 3 miles; Guelph northerly to Kitchener Road, 0.6 miles; London easterly, 3 miles; Chatham westerly, 4 miles; Oldcastle easterly, 3 miles; Windsor City line to junction with County Road, 4 miles; Niagara Falls northerly, 1.6 miles. Total, 36.95 miles.

Asphaltic concrete pavement—End of pavement at Dunbarton to deviation just east of Highland Creek Post Office, 4½ miles; Yonge Street, from Mausoleum northerly, 5 miles (alternative bid), one tender on 7-inch loose stone compacted Macadam base, one tender on 5-inch concrete base (mix 1-3-6); top of Ancaster Hill westerly to Wentworth (stone in quarry at Ancaster) County line, 7¼ miles; Winona westerly to junction with Stoney Cr. Rd., 4 miles; Galt to Preston, 1½ miles; Galt to Wentworth County line, 3 miles. Total, 25¼ miles.

Bituminous penetration—Green's Creek to Orleans, 3½ miles; Yonge Street, from Toronto City line north to Mausoleum, 1-4 miles; Clappison's Corners to Black's Corners, 3 miles; Welland Ship Canal to St David's, 4¾ miles. Total, 12.65 miles.

Macadam roadway—From Barriefield north-easterly, 4 miles; from end of Macadam, south of Peterboro, southerly, 5 miles. Total, 9.0 miles.

Macadam base course—Carling Ave., from Ottawa City line westerly, 4 miles; from junction of Richmond Road and Base Line Road (includes grading) to Stittsville, 5¾ miles; Cooksville to Brampton (includes grading), 9¼ miles; Dundas Street, from east limit Township of Nelson, 4 miles; Niagara Falls toward Welland (includes grading), 8 miles; Welland westerly (part of stone at stockpile at Hewitt), 4 miles; Jarvis westerly (includes grading), 4 miles; Yonge's Mills easterly, 4.8 miles. Total, 43.8 miles.

Earthwork and rockwork—Bloor St., from easterly limit of City of Toronto, easterly (including subway under G. T. Ry.), 2 miles; Dundas Street, from west of Cooksville westerly to 16-Mile Bridge, 9¾ miles; Kitchener to Stratford, 24 miles; Guelph easterly, 5 miles; Preston to Freeport, 2.3 miles; Dundas Mountain Road, 0.7 miles. Total, 43¾ miles.

## TORONTO CONSULTING ENGINEERING FIRM OPENS UP IN WEST INDIES

James, Proctor & Redfern, Limited, consulting engineers of Toronto, have widened their business connections by opening an office at 32 Spry St., Bridgetown, Barbados, from which office it is intended to serve the British West Indies. Mr. John Wilson, formerly of the engineering staff of the Ontario Hydro-Electric Power Commission, Niagara Falls, Ont., has been placed in charge of this office.

It is the intention of this company to carry on a consulting engineering business among the islands. It is also their intention to act as purchasing agents for municipalities and private corporations in connection with the purchase of engineering equipment, etc.

Mr. E. M. Proctor, managing director of the firm, will leave for the West Indies in the first week of December on an extended business trip in the interests of his firm.

Considerable work is projected throughout the islands, and having regard to the fact that there is a preferential tariff in favor of the Canadian trade, also preferential freight rates to the coast, considerable business should be opened up between Canada and the West Indies.

## LONDON CONCRETE MACHINERY CO. ACQUIRES BUSINESS OF THE IDEAL COMPANY

The London Concrete Machinery Co., of London, Ontario, have purchased the business of the Ideal Concrete Machinery Co., of Windsor, and are moving the entire plant to London. The Ideal line consists of the Ideal concrete block machine, Ideal power tamper and ornamental moulds. The concrete block machine makes the face of the block in the bottom of the mould, allowing the blocks to be faced with richer material; it also uses a horizontally withdrawn core. This company claims the control of the basic patents covering these features, also many other patents in block making machinery.

The London Concrete Machinery Co., who already have a very large business in the well-known London line, covering concrete mixers, hoists, pumps and other contractors' equipment, are making provision for greatly increasing the output of Ideal concrete block machines. Their new catalogue covering this line will be issued about December 1st and will be mailed on request.

## ASPHALT ROOFING CO. BUILDS NEW PLANT

Toronto Asphalt Roofing Manufacturing Co., Ltd., Mount Dennis, Ont., have completed plans for the erection, beside their old plant, of a solid brick, one-storey warehouse, 61 ft. x 93 ft. Tenders are being called at once.

# Cement Gun Lines Mine Shaft Without Interfering With Operation

### Reinforced Concrete Lining in Upper Part With Self-Supporting Gunite Wall in Lower 185 Feet—Gunite Shelves Carry the Lining Which is Reinforced With Expanded Metal

Somewhat unusual methods, described in a recent issue of "Coal Age," by R. H. Gillespie, were employed recently in the construction of a permanent self-supporting lining in the hoisting shaft of No. 1 mine of the Lake Superior Coal Co. at Superior, W. Va. The sinking of this shaft began in 1906 and was completed, including the placing of the timber lining, as far as the Pocahontas No. 4 bed—185 ft. below the surface—in December of that year. Early in the autumn of 1910 it became desirable to increase the depth of the shaft so that the Pocahontas No. 3 seam of coal, lying 240 ft. below the surface at this point, might be available for mining.

Although the Lake Superior Coal Co. still has a large acreage of coal in the upper measure, little mining has been done in the No. 4 bed for a number of years, all operations being confined to the lower measure. However, in lining the shaft throughout its entire length with concrete, it was necessary to make ample provision for the future mining of the upper bed.

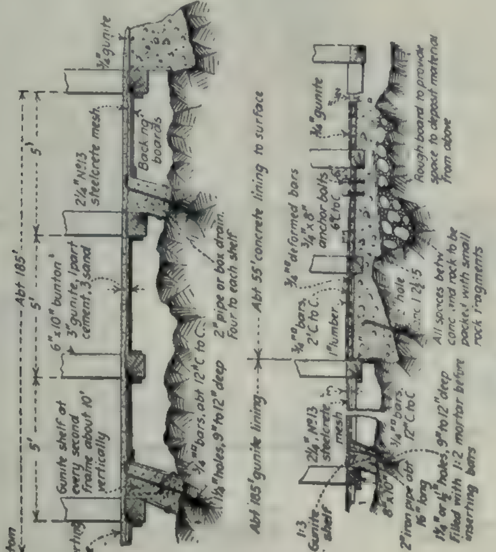

¾" gunite
Backing boards
2¼" No. 13 steelcrete mesh
Abt 185'
5'
5'
5'
6" x 10" bunton
3" gunite, 1 part cement, 3 sand
2" pipe or box drain. Four to each shelf
¾" □ bars, abt 12" C to C
1¼" holes, 9" to 12" deep
Gunite shelf at every second frame about 10' vertically
Self supporting gunite
To bottom
Abt 185' gunite lining
Abt 55' concrete lining to surface
¾" gunite
Rough board to provide space to deposit material from above
¾" □ deformed bars
¾" x 8" anchor bolts 6' C to C
⅜" □ bars 2' C to C
1" lumber
hole
conc 1 2½ 5
All spaces betw. conc. and rock to be packed with small rock fragments
2¼" No. 13 steelcrete mesh
¾" □ bars 12" C to C
1:3 Gunite shelf
8" x 10"
2" iron pipe abt 16" long
1¼" or 1⅛" holes, 9" to 12" deep filled with 1:2 mortar before inserting bars

Fig. 1. Shaft lining of concrete and gunite. On the left is shown the lower 185 ft. which is gunited. The ¾-in. square bars in the gunite shelf, or ring, are bent alternately up and down. The section on the right shows the concrete lining in the upper part of the shaft where support of the sides is needed. It also shows at the bottom some of the gunite lining. Where the space permits a board is set as backing to the concrete, and the vacuity back of the board is filled with rock fragmnents or other imperishable material as shown in the upper part of the section on the right. Where the concreting ended a footing was cut in the rock to support the lining above.

## Landslide Discharges Rock Into Shaft

For a distance of 45 ft. from the surface the shaft was sunk through earth, clay and loose rock, the remaining distance to the bottom being through hard rock bearing a considerable amount of water. In March, 1914, a serious landslide occurred, coming from the north, or uphill, side of the shaft. This closed down the mine for more than a month. During this time the material that slid into the shaft opening was removed and the timber lining repaired. One of the chief items of repair consisted in filling up in the rear of the shaft a large cavity made by the moving earth. This opening extended northward into the hillside a distance of 20 ft. from the shaft collar, and was approximately 35 ft. in depth. More than three carloads of green round timber were used in the building of cribs adjacent to the shaft lining on the north side. This structure was then packed and the remainder of the cavity filled with loose earth.

The inside dimensions of the original shaft with its timber lining were 14 x 20 ft., space being provided for two cage compartments and a pipe gallery. During the summer of 1919 the condition of the old timber lining became such as to make extensive repairs, or the substitution of a new lining, imperative. The Superior company accordingly entered into a contract with the Trayolr-Dewey Contracting Co., of Allentown, Pa., for the installation of a reinforced concrete lining in the upper portion of the shaft and a self-supporting and reinforced gunite lining from the concrete to the shaft bottom.

Work on relining the shaft was begun about Oct. 1, 1919, and carried on continuously, except for a few interruptions arising from slow delivery of materials. It was completed early in January of 1920, the work being performed without interfering at any time with the operation of the mine. The new construction work was done at night, the shaft being utilized for hoisting during the day.

The concrete lining in the upper section of the shaft was placed first. A shelf was excavated in the solid rock at a depth of 55 ft. to form the foundation for the concrete side walls. The work was attacked in sections, the advance being limited in each case to the distance between a pair of range timbers. All the old timber lagging and vertical posts in that section were removed and trench braces were employed temporarily to take the place of the posts withdrawn. Steel reinforcement consisting of ¾-in. square corrugated bars was then placed.

The horizontal bars were spaced on 6-in. centres, while those extending vertically and serving merely as a means for spacing the horizontal members, were placed on 2-ft. centres. One-inch rough boards functioning as face forms were than attached to the range timbers and the concrete—composed of a mixture of 1 part cement, 2½ parts sand and 5 parts broken stone—was lowered in barrows from a Ransome mixer at the top of the shaft and poured. In this latter operation care was taken to work the concrete well back into all the irregularities of the rock.

### Concrete Built in Five-foot Sections

In this manner the concrete walls were carried up in sections 5 ft. in height, the range timbers being removed as the concrete was brought up to them. In order that the bottom of the face forms on succeeding sections might be held more firmly in position, heavy wires were cast into the upper portion of each concrete slab.

Rectangular wrought-iron plates, ½in. thick, were bent to special shape and cast into the east wall at 5-ft. intervals to serve as supports for the cage guides. Back of each a hand-hole recess was formed in the concrete to permit of easy access when renewal of the guides became necessary. Each end of the bunton timbers was fitted with a 6 x 12-in. steel plate, 3 ft. long, bent and bolted to these members so as to form a 6 x 4½-in. projection which rested in the recesses provided in the concrete walls. The new buntons were installed as the walls were carried upward; being placed as a rule about 12 in. below the old buntons.

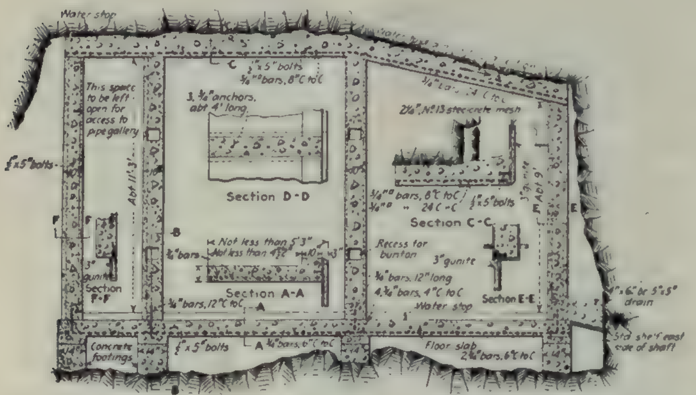


Fig. 2. North Portal. On north side of shaft looking north from shaft at 180-ft. level. The various footings and the floor slab were cast each in a single operation. Pier steel and forms were then placed, each pier constituting a monolith. Forms and steel were then placed for roof slab, which was cast integrally.

Throughout the portion of the shaft driven through the earth and loose rock all the old timber, cribbing and packing that had been placed after the landslide to serve as a footing to the hill slope was removed in advance by the men constructing the new walls. In its stead other material—mostly ashes—was used to fill the void. The removal of the old timber proved to be a particularly dirty, tedious and dangerous operation, as every kind of wood refuse was encountered, including many green logs and in some instances stumps of trees.

As soon as the concrete walls had risen above the firm rock rough back forms were provided so as to make the thickness of the walls not less than 10 in. When these walls were poured all space back of them was compactly filled with ashes. A coating of gunite, about 1 in. in thickness, was then shot over the inner concrete surface for the purpose of filling any voids that existed. In this manner the surface was thoroughly sealed and made waterpoof.

### Gunite Shelves at Ten-foot Intervals

As has been already mentioned, the section of the shaft that had been sunk through the rock was lined with self-supporting reinforced gunite. The methods employed in this construction consisted of building at 10-ft. intervals, or immediately above every second range timber, a gunite shelf approximately 10 in. in thickness. This ledge was constructed on all four sides of the shaft. The work was accomplished by drilling 1½-in. holes in the rock at horizontal intervals of about 1 ft., into which were grouted ¾-in. square corrugated bars, bent and hooked in such a manner as most efficiently to take up the tension and engage the reinforcement in the gunite slabs that were to be constructed later.

Rough shooting forms were then placed and the shelves shot with a cement gun. The faces of the shelves were left rough and about 2½ in. in rear of that of the finished lining. In providing for drainage, an opening was formed in each shelf on each of the four sides of the shaft by casting in a short piece of 3-in. pipe or a wooden box 4 in. square.

### Where Rock Was Broken Brackets Were Built

When rock was encountered that had been shattered so far back from the finished lining as to make this type of shelf construction impractical, heavy brackets were cast. These were generally of concrete and thoroughly anchored to the rock by means of ¾-in. corrugated bars that had been previously grouted into holes drilled for that purpose. From bracket to bracket a reinforced gunite beam was formed. This, as a rule, was about 10 in. wide and of varying depth, depending on the length of the span. Into the inner face of the beam ½ x 5-in. machine bolts were cast with heads projecting 1 in. to permit of fastening the reinforcement of the lining slab.

All wooden posts were then removed so that the range timbers were supported by the 1-in. material used for backing during the shooting operation. Forms were placed for gunite posts at the bunton ends and at the centre of the east side of the shaft; the latter to provide a body of gunite within which the iron guide supports could be embedded. Where the posts intersected the range timbers 4 in. was cut away from their back so that the posts would be continuous from shelf to shelf. The thinner sections of the posts or the points where they crossed the range timbers were reinforced with ¾-in. steel bars.

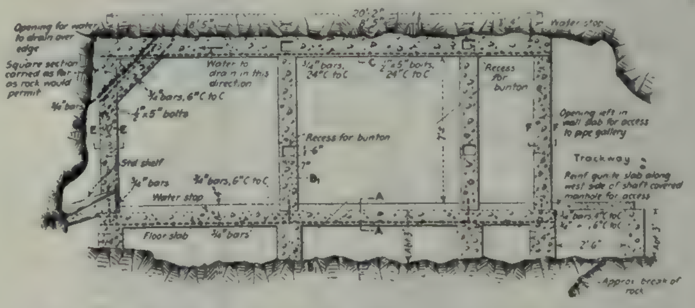


Fig. 3. South Portal. At 180 ft. level, on south side of shaft looking south from shaft. On left is shown appearance where rock permits square construction and the concreting method where the rock follows the heavy dotted line. For cross-sections and erection methods see Fig. 2.

### Expanded Metal Reinforces Gunite Lining

Backing or shooting forms were made of rough 1-in. lumber nailed to cleats attached to the range timbers or wedged against the gunite shelving. These boards were spaced from 6 to 12 in. apart and covered with tar paper. No. 13 expanded metal or "steelcrete," which formed the reinforcing for the slabs, was then put in place and securely fastened to the bar or bolt anchors already mentioned.

The gunite slabs then were shot to a finished thickness of 3 in. with the cement gun operating under an air pressure of from 30 to 50 lb. per square inch. The gunite was composed of one part cement and three parts of well-screened sand. As in the case of the concrete lining, recesses were formed in the gunite for all bunton supports, as well as hand holes at all guide fastenings along the east side of the shaft.

### Footing Piers Built Out From No. 4 Bed

Where the shaft intersected the No. 4 bed—180 ft. below the surface—four concrete footing piers, each 14 in. wide and extending from 4 to 7 ft. from the shaft line into the heading, were constructed on each side of the shaft. As these piers had to be cantilevered beyond the edges of the rock in order to reach the shaft lines, they were heavily reinforced in their top sections and anchored to the floor with steel bars set deep in the rock. On these piers a reinforced concrete landing slab 8 in. thick was constructed. Superimposed on the slab and directly over the cantilevered footing piers, concrete piers 10 in. in thickness and extending from the shaft line into the heading from 4 to 6 ft. were built.

The piers support a reinforced concrete roof slab which serves both to hold up the roof at the shaft and the gunite lining at the top of the portals. In order that this type of construction might be the more easily carried out, ½ x 5-in. anchor bolts were cast in place with heads projecting, to which was fastened the expanded metal lining reinforcement. This means of support for the lining likewise is provided in the face of the end piers and the landing slabs. Cut-off walls were constructed at the back of the landing slabs; these extended down to the rock floor to prevent mine waste from falling down the shaft and behind the lining. Upon removing the forms from the reinforced concrete, all accessible surfaces were sealed off with a thin coating of gunite.

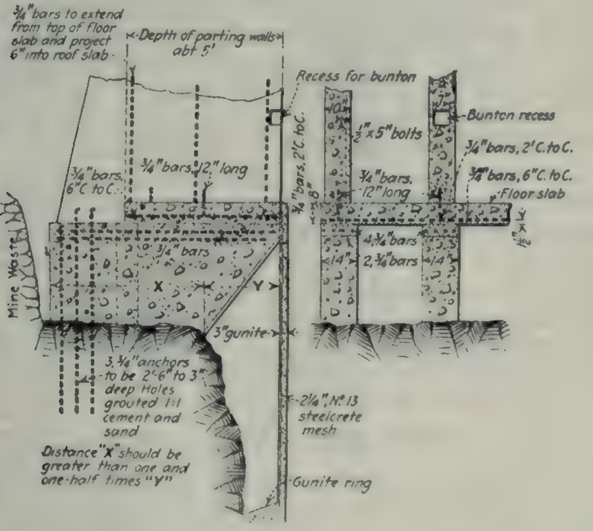

¾" bars to extend from top of floor slab and project 6" into roof slab
Depth of parting walls abt 5'
Recess for bunton
Bunton recess
10"
½" x 5" bolts
¾" bars, 2' C. to C.
¾" bars, 6" C. to C.
¾" bars, 6" C to C.
¾" bars, 12" long
¾" bars, 2' C. to C.
8"
¾" bars. 12" long
Floor slab
Y
X
¾" bars
4, ¾" bars
14"
2, ¾" bars
14"
Mine Waste
X
Y
3" gunite
3, ¾" anchors to be 2'-6" to 3' deep Holes grouted 1:1 cement and sand
2¼", No. 13 steelcrete mesh
Distance "X" should be greater than one and one-half times "Y"
Gunite ring

Fig. 4. Section B-B in Fig. 2 and 3. This illustration shows how the portals are brought out to the edge of the shaft and are bedded with anchors to the rock at the shaft side; also how the gunite of that part of the shaft below the 180-ft. level is hung as a curtain from the portal and is sustained by a gunite ring or shelf.

Where the shaft intersected the No. 3 bed—240 ft. below the surface—concrete was built from the mine floor to the roof as in the bed above. In this instance, however, the gunite shaft lining terminated 10 ft. above the roof, as the last 10 ft. of the shaft was lined with a concrete wall. This lower section was constructed in the same manner as the wall near the surface, except that the reinforcing rods which were used in the upper sections were in this case omitted.

### Water Conducted Freely Behind Lining

When the relining work was started the shaft was extremely wet, particularly the upper 50 ft. of its length. After the work had been completed no water was to be found inside the lining excepting that resulting from leaking steam pipes and from condensation. All the water reaching the shaft was drained from shelf to shelf and finally led from the lowest shelf through a pipe to a sump where pumps were located.

The intake air current of this mine passes down an airshaft and after circulating through the workings returns through a crosscut leading directly to the hoist. In the past no definite steps had been taken to prevent this flow of gas-laden air from coming in contact with the wires serving the electric locomotives. At the bottom of the shaft an overcast was constructed to permit the return air to pass to and up the hoist shaft in such a way as to avoid touching the electric wires furnishing power for the operation of the mine.

At the north side of the shaft bottom and opposite the entrance of the crosscut mentioned, six concrete columns each 12 in. square were constructed in such locations as not to interfere with the mine tracks and car clearances. On these columns, together with the piers supporting the north side of the shaft lining, reinforced gunite beams were built. These in turn supported a reinforced gunite floor 3 in. in thickness at such a height above the floor of the mine as to give a clearance of 6 ft. 6 in. over the tracks, leaving a height of from 3½ to 5 ft. between overcast floor slab and mine roof.

The lower half of the crosscut was shut off by the construction of a concrete wall extending from the track level to the floor of the overcast, so that the space above that floor could be utilized for the admission of the air. An opening was left in the wall for access; this was fitted with a large plate door. The balance of the overcast was then enclosed by gunite walls extending from the floor to the roof, with the single exception of the shaft side. Thus the gas-laden air passes by way of an overcast to the hoisting shaft.

### Lined 135 Lineal Ft. With Gun on Surface

While sinking to a depth of 135 ft. from the ground level the cement gun was located on the surface, only the nozzle being in the shaft. For the remainder of the work the gun was moved down to the landing at the No. 4 bed, being supplied with cement and sand lowered on the cage.

It is believed that the old range timbers left in place will rot and in time fall to the shelf below. As this distance, however, will in no case be as great as 10 ft., no damage is expected. Because of the nature of the work and the difficulties and hazard encountered, progress was necessarily slow. Practically all of the work had to be done from the cage and, as its floor dimensions were but 7 x 12 ft., it was only in rare instances that more than four men could be employed to advantage simultaneously.

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## A PAMPHLET ON THE TARIFF

The Canadian Manufacturers' Association has issued a pamphlet entitled "The Tariff, Why Canada Needs It."

# Handling and Renewal of Railway Ties

## Committee Report Presented at the Annual Convention of the Roadmasters and Maintenance of Way Association, Chicago

Records kept on a system of 9,000 miles of road for 15 years or more show an average annual renewal of 340 ties per mile of track, or an average of 10.63 per cent. per year. This is an enormous item of expense and is probably the largest single item in railway maintenance. Rails are taken out when worn and transferred to light-traffic lines, and when they have served their life there they are taken out and sold for scrap at approximately one-third of their original cost. But not so with ties, for every 10 years must see an entire renewal. It therefore behooves every maintenance of way officer and member of this Association to conserve, preserve and prolong the life and usefulness of every tie in his railroad.

### Estimates for Tie Renewals

Practically every road represented in this Association has some method or system of inspection to determine the estimate for tie renewals for the coming year (some roads have very elaborate systems, while others are simple, plain estimates, all tending to the same end), and upon this inspection or estimate ties are allotted and bought and their distribution is made.

Great care should be exercised in making this estimate so that it will represent a true condition to the management. Data concerning tie renewals which have been preserved and estimates for a series of years are a valuable check, for which such data an officer can determine what part of his system is costing the most in tie renewals, and he can then investigate the causes and apply the remedy.

Sometimes apparently excessive estimates are due to a change from light traffic to heavy traffic on certain lines, and from a light ballast section to heavy ballast application, necessitating heavy renewals. Also a more progressive division officer sometimes may have a higher standard and estimate per mile than the traffic on his district will justify. With these data at hand, the officer who passes on the final estimates and allowances may determine intelligently what is needed for the next year's renewals; and upon this final estimate or allowance the purchasing agent, supply department or distribution office arranges to purchase and furnish the ties to the various districts and divisions of his road.

### The Supply and Distribution of Ties

The supply and distribution of ties for renewals on roads of 1,000 miles or less which have the tie timber on their line is an easy matter. But for a large system, where the majority of its ties must come from some other road or a distant part of its own system and go through the treating plants, be reloaded and shipped to the various divisions, a well-trained and systematic organization is required. When possible to do so, ties that are treated should be surfaced or dapped and bored for tie plates, as it saves adzing and prolongs the life of the tie.

The purchase, supply and distribution of ties must interlock one year with another, and ties must be coming to the road every season of the year. On small roads which have their own ties, which are not treated, it is preferable to leave the ties in the original piles at the source of supply when purchased until early in the spring and then load and distribute them directly to the divisions according to the previous estimates and allotments, so that the work of tie renewals may be started as soon as the season will permit. These ties should be distributed from cars to the various sections as needed.

On larger systems of 2,000 to 8,000 miles of road whose supply is far away this practice cannot be done, for ties must be moving through the treating plants continually and be handled when the car supply and motive power can be utilized to the best advantage. Oftentimes in the spring and summer when the needs are greatest one cannot get the cars or engines. He must therefore run his ties through the treating plants and get them out on the remote divisions early in the winter and spring, when labor, cars and power can best be spared for this work.

The loading of ties at the source of supply can be handled more economically by contract than with section or extra gangs, as one experienced tie loader working by contract will load more than two average section men and at much less cost. It is also a heavy burden on the remote division or territory to take its maintenance forces to load ties for other districts.

On roads where the necessity does not require it ties should not be scattered along the track during the winter for next summer's renewals, but they should be unloaded and piled in small piles of 25 or more at convenient points for distribution by push car in the spring, or as needed. Later in the spring and in the summer when actual renewals have begun, ties should be scattered from cars as nearly as possible where needed to save handling by push cars.

### Application of Ties in Track

The roadmaster and foreman on any section or division should and does know what his allowance and necessities are on any given territory, and should have his ties distributed as nearly in accordance therewith as possible. Here is where economical methods of application come in. On old ballasted or dirt track all ties needed for the year should be applied at one time going over and the track be resurfaced and dressed, as necessities require. The practice of making three or four applications of ties per year over a territory is expensive and is not conducive to good and economical track maintenance.

Where heavy ballasting or reballasting is to be done ties can be renewed more economically at the time of ballasting, especially where heavy rock, slag or cement ballast is being placed than prior to the ballast work. On many lines, on account of weather, soil or labor conditions, it is necessary to rush tie renewals to the exclusion of other work during certain periods, while in the southern half of the territory represented in our Association ties may be renewed at almost any season of the year. However, even in that territory, it is preferable to renew ties between the months of March and November, devoting the time during the winter months to other equally important work.

The use of tie tongs prolongs the life of ties. The insertion of picks in the top sides or surfaces of ties

*No. 29*

## *Canada's Contractors—H. C. Johnston*

**One of the most interesting developments in connection with our engineers' and contractors' series has been the evident attraction of the construction field for many men of scientific training and experience. The desire to build seems to take strong hold of the engineering mind. Mr. Harold C. Johnston, vice-president and general manager of the H. C. Johnston Co., Ltd., general contractors of Montreal, also belongs to this class. He was born in Carleton Place, Ont., but his parents later moved to Raleigh, North Carolina, where he received his early education, including several years at the engineering college there. He afterwards returned to Canada and completed his course at the University of Toronto, receiving the degree of B.A. Sc., in 1910, in civil engineering. He then spent some years in charge of engineering and building work for the Canadian Pacific Railway and also for the Grand Trunk Pacific in the West. He afterwards held a position as an assistant to the city architect of Toronto, and from supervising the work of contractors, he finally became a contractor himself, doing business in Toronto and later joining the contracting firm of Anglins, Limited, now Anglin-Norcross of Montreal. He finally organized the contracting firm of H. C. Johnston Company, Limited, who have been carrying on a general contracting business for the last three years. Among their latest contracts might be mentioned the Holt, Renfrew Company's offices and fur storage vaults, costing about $200,000; also considerable work for the Canadian Car & Foundry Company, and the R. W. Bartram Company's warehouse just being completed in Montreal. Mr. Johnston is an associate member of the Engineering Institute of Canada, and a member of the Montreal Kiwanis Club.**

Mr. Harold C. Johnston

should be strictly prohibited, as this practice hastens decay and reduces the life of ties.

What has been said above of cross ties is equally applicable to switch ties, except in heavy yards. At outlying points switch ties should be inspected the same as cross ties and only such as have served their life removed. Whenever 60 per cent. or more of the ties in any given switch are to be removed it is good maintenance to remove the entire set and use the good ties taken out in other nearby back tracks when needed. In yards or heavy terminals, interlockers or crossovers where traffic is heavy, a track should not be disturbed until necessities require, and then renewals should be complete and permanent. Any good ties removed can be used elswhere with light cost for handling. A comparative statement of the number of ties removed per man per day and per month on section and roadmaster's districts stimulates renewals and lessens the cost per tie. However, unless watched and checked closely, ties are often removed from track which have a year or more life in them.

Tie renewals can be made more economically with a small force of eight men or less than with a large gang except incident to the application of ballast and rail laying, and even these gangs should be split for this particular kind of work. In heavy renewals or in busy terminals the interruption of traffic should be considered rather than economy in maintenance. Proper methods of spiking and careful plugging of spike holes extends the life of ties and saves time.

### The Piling and Disposition of Old Ties

This is no small item of expense in the renewals and is a legitimate charge to this account, and must be so considered. The increased cost of labor both in the maintenance of way and transportation departments makes it prohibitive to load and haul old ties into terminals for engine wood, as was done in years gone by and one must get rid of them the cheapest and quickest way. In terminals they must be hauled out and burned or given away for quick disposition.

On roads in the west, where fuel is scarce, farmers and patrons of the road will gladly haul them away and use them and in many instances render some valuable service for them, such as plowing fire guards, giving right of way for snow fences, etc. This practice should be encouraged, as it saves time and money, and lessens the cost of the renewals and encourages a kindly feeling between the railroad and its patrons. However, unless these old ties are removed in a short time, they should be piled and burned and the right of way and grounds kept clean.

The handling and renewal of cross and switch ties covers the period from the original inspection and estimate until the final work is done, the old ties removed and the track and grounds dressed up. It requires constant supervision and attention to save time and timber.

## TO PREVENT CREEPING OF ASPHALT PAVEMENTS

The Asphalt Association has begun experiments calculated to remedy and prevent in the future such shoving and creeping as may occasionally develop in asphalt paving. Engineers of the U. S. Bureau of Public Roads are co-operating with the Asphalt Association in the work. Cordial co-operation on the part of city engineers is also being encountered. The investigation promises to become far-reaching and effective.

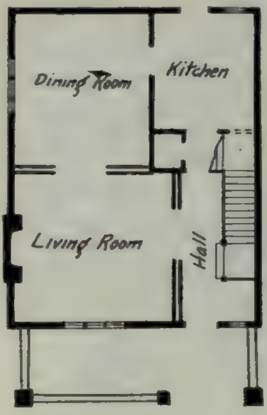
# *A House Plan Suggestion*

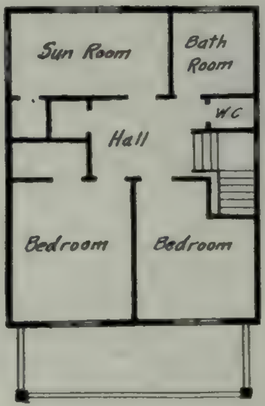
### *One of a Series of Designs Presented From Time to Time in the Contract Record*

The attractive 6-room bungalow-type residence illustrated herewith is nearing completion on Westlake Ave., Danforth district, Toronto. Buff tapestry brick, with stone trim above and below all window and door openings and around verandah, is used throughout in the exterior construction. Wooden shingle roofing, stained tile-red, lends considerably to the attractiveness of the exterior appearance. The basement occupies the full area of the house, is floored with concrete and contains hot water heating plant, fruit storage, enamelled laundry tubs and storage space for coal. The ground floor is laid with quarter-cut oak flooring throughout, with the exception of the kitchen, where pine is used. Downstairs trim is also of oak throughout. The front entrance opens on a long hallway running the length of the living room, on the left, with entrances to this room and to the kitchen, as shown on the accompanying floor plan. There is a built-in seat in the hall situated at the foot of the panelled oak staircase. The living room is the largest room on the ground floor, 13 ft. x 14 ft., and is equipped with sliding doors between hall and dining room, and with tapestry brick fireplace on the north side of the room, as shown on plan. The dining room is 11 ft. x 14 ft. and is especially attractive by reason of the beam ceiling plastered with interior stucco. There is a swinging door connecting this room with the kitchen. The latter room is 9 ft. 9 in. x 12 ft. and is well equipped with built-in cupboard accommodation and ironing board, and is wired for electric range. The little room shown on the plan between the hall and kitchen is for coats, etc., and is equipped with oak door in which is set a bevelled plate glass mirror, the full length of the door.

The upstairs is trimmed throughout with chestnut, plain oak floors being laid in every room. There are two bedrooms and sunroom on this floor, the two bedrooms at the front of the house being of the same dimensions, each 10 ft. 2 in. x 14 ft. As indicated on the accompanying plan, the bedroom on the north side of the house will contain a tapestry brick fireplace, the same as in the living room downstairs. The rear half of the upstairs plan comprises the sunroom, bathroom and separate toilet. The walls of the bathroom and toilet are of white oblong tile, half way up. Convenient access may be had to any of the rooms on this floor from the large square hall at the top of the stairs. Plenty of closet space is provided in all bedrooms.

Provision has been made for ample lighting of the interior by both natural and artificial means, several windows of the French casement type being provided on all sides of the house, while each room has been thoroughly wired for electric light and service. As seen in the illustration, a double brick garage is being built at the hear of the house. Tapestry brick was also used in this construction.





The builder and owner of this very attractive and sturdy bungalow is Mr. Frankish, Toronto.

## ACTIVITY IN SAULT STE. MARIE

Building has been active in Sault Ste. Marie during the past season, construction to a total value of about $800,000 having been carried out. The big item in this expenditure is the new court house, which is nearing completion at the present time. This structure is of brick and stone construction and will cost about $400,000 when completed. The work of plastering and interior decorating is being carried out at the present time. Residence building played an important part in the past season's activities, it being estimated that about 150 new houses were erected. A start has just been made on the $250,000 Technical School and the proposed addition to the High School there will cost $125,000.

# Mainly Constructional

### East and West—From Coast to Coast

Fire losses in Canada during the week ended November 16, are estimated by the Monetary Times at $287,850, compared with $215,500 the previous week.

It has been announced that the government of British Columbia will appoint an engineer to investigate the cause of the recent disastrous flood at Britannia Beach.

A fire at Calgary recently destroyed the Woolworth store and Royal Bank building, at Central Street and Eighth Ave., resulting in a loss estimated at $200,000. The double fire wall on the east side of the building prevented the fire from spreading in this direction.

The city of Toronto's share in the cost of paving in connection with the Transportation Commission's rehabilitation work will amount to approximately $800,000 this year. This will include the new paving on the Teraulay Street extension and the repaving of Coxwell Avenue and north Yonge Street.

The new highway bridge connecting Annapolis and Granville, N.S., was officially opened recently by Hon. H. H. Wickwire, provincial minister of highways, and Mr. A. F. McMillan, chairman of the Highways Board. The bridge is 2,272 ft. in length, the longest in the province, and was erected at a total cost of $317,000.

Erie Hotels Company has secured a charter to erect two summer hotels at Port Dover, Ont., at a total expenditure of at least $100,000. The charter gives the new company power to erect and operate hotels, billiard halls, cafeterias, auto parking stations, bowling and tennis grounds and every conceivable sort of pleasure device.

It is reported that the authorities of McMaster University, Toronto, have practically decided on Carroll's Point, near Hamilton, as the site for the proposed new university building. A proposal was approved, at the last Baptist Convention, to move the site of the university to Hamilton, and a committee appointed for the purpose has been endeavoring to secure a suitable location.

The ratepayers at St. Thomas, Ont., recently passed a bylaw authorizing the expenditure of $100,000 on the erection of the Elgin Memorial Hospital. The estimated cost of this building is $165,000, the former figure being but the city's share of the total cost. The county of Elgin will be asked to subscribe $50,000, and the balance, it is anticipated, will be secured through township grants.

Exterior construction work on the new Prince Edward Hotel, at Windsor, Ont., has been completed, and work on the interior will be proceeded with throughout the winter months. The building is a ten-storey structure and will represent an investment of approximately $2,000,000. It is expected that the official opening will take place some time in June of next year.

The city of Toronto is planning its winter program of construction to start simultaneous with the cessation of work on the Toronto Transportation Commission's rehabilitation work. This action is being taken to absorb as many as possible of the men now engaged on the latter contract, who will find themselves out of a job as soon as the real winter weather sets in. There are from 2,500 to 2,600 men now engaged on the commission's work.

The Ontario Government has decided to take over the administration of the Toronto-Hamilton Highway, now that the entire work of construction has been completed, and has asked for the resignations of the members of the existing commission. No reflection is cast upon the administration of the present commission by asking for their resignations, the government simply feeling that this road should now be under the direct control of the highways department.

A new $600,000 hotel is rumored at Sault Ste. Marie, Ont. The matter was placed before the local Board of Trade, who looked favorably upon it and will bring the scheme to the attention of the city council, Rotary Club and other local organizations for consideration shortly. There is a possibility of incorporating the matter in a municipal by-law to be voted on by the citizens at the coming elections. A former citizen of the Soo, now situated at Montreal, is said to be behind the scheme.

Some interesting figures compiled by Mr. S. L. Squires, chairman of the executive of the Canadian Good Roads Association, and made public recently, are to the effect that prior to 1912 a total of $40,000,000 was expended on highways in the province of Quebec, and since that year a total of $30,000,000 has been spent on this system of roads. The number of foreign cars entering the province during 1920 totalled 34,435, from which a revenue of $33,867,200 was derived. It is anticipated when this year's total is compiled, the revenue from this source will total approximately $35,000,000.

## Personal

Messrs. James, Proctor & Redfern, consulting engineers of Toronto, have been employed by the town of Gananoque to supervise the paving of Main Street in that town.

Mr. W. G. Ross, who is contesting the St. Antoine division, Montreal, in the Conservative interests, recently announced that he had resigned as president of the Harbor Commission, in view of his candidature for Parliament. Mr. Ross has been president of the Harbor Commission for the past nine years.

Mr. A. R. Whittemore, of MacLean Building Reports, Limited, Toronto, addressed the Rotary Club in that city recently, on the building situation in Canada. He pointed out the important bearing the construction industry has on the employment situation and spoke very optimistically regarding next year's building prospects.

## Trade Incorporations

Moose Jaw Engineering Co., Ltd., with head office at Moose Jaw, Sask., capital $20,000, to carry on a general engineering business.

General Transport Co., Ltd., with head office at Toronto, capital $40,000, to carry on the business of road contractors and to rent motor trucks and machinery for road contracts.

Frank Barber & Associates, Limited, with head office at Toronto, capital $200,00, to carry on the business of civil and structural engineers. The firm has hitherto been known as Barber, Wynne-Roberts & Seymour.

# CONSTRUCTIONAL ACTIVITY

## Period of November 23 to November 29, 1921

***Dominion Wide Service Exclusive to "Contract Record & Engineering Review"***

### Waterworks, Sewerage and Roadways

**Fredericton, N.B.**

P. J. Veniot, Minister Dept. Pub. Highways, Prov. Govt., Fredericton, will receive tenders until Dec. 10th for contract No. 30, roadwork from Indian Village to Long's Creek to Rosborough. Plans at offices of Chief Engr., Fredericton, and Prov. Govt. Rooms, St. John, N.B. Certified cheque for $5,000 required.

**Ottawa, Ont.**

Plans and estimates will be prepared for asphalt resurfacing Carter St., Lisger to Argyle Ave., for City. A. F. Macallum, Commr. of Works.

#### CONTRACTS AWARDED

**Amherstburg, Ont.**

General contract for sewer extension on Fort. St. for Town Council is awarded to Pettypieces, Ltd.

**Penticton, B.C.**

General contract for construction of dam and overhauling irrigation system at cost of $150,000 for Kaleden Estate, Penticton, is placed with Robertson & Partners, 1004 Credit Foncier Bldg., Vancouver.

**St. Lambert, Que.**

Contract for concrete pipe for Town is awarded to Independent Concrete Pipe Co., Ltd., Huron St., Woodstock, Ont. Contract for laying of pipe and sanitary sewers is placed with Leger, 76-A Rird Ave., and Tardiff, 60 Adam St. Project will cost $53,000.

### Railroads, Bridges and Wharves

**Sarnia, Ont.**

Construction of ferry landing is contemplated by Port Huron-Sarnia Ferry Co. Chester C. Woods and Geo. L. Harvey, assoc. architects, 219½ Christina St.

**Cowichan Bay, B.C.**

Fraser River Pile Driving Co., Ltd., New Westminster, B.C., are awarded general contract for construction of wharf costing $8,017.21 for Dominion Govt., Dept. Pub. Works.

**Moncton, N.B.**

Plumbing and roofing contracts for storage bldg. costing $8,000 for C. N. Rlys., West Main St., are awarded to T. Johnston & Co., Ltd., 895 Main St., Moncton, and Barrett Co., Ltd., Dennis Bldg., Halifax, N.S.

**Sandspit, B.C.**

General contract for construction of wharf costing $8,327.77 at Moresby Island, Queen Charlotte Group, Skeena District, for Dom. Govt., Dept. Pub. Works, is placed with McDonald, Watson & Wither, 520 Sayward Bldg., Victoria, B.C.

**Steveston, B.C.**

General contract for construction of jetty costing $61,981 for Dom. Govt., Dept. Pub. Works, is placed with J. S. Connell, Ltd., Vancouver.

**Tofino, B.C.**

W. L. Thomson, Ucluelet, B.C., is awarded general contract for construction of wharf in Comox-Alberni District for Dom. Govt., Dept. Pub. Works.

### Public Buildings, Churches and Schools

**Langley, B.C.**

Erection of school is contemplated by Langley School Bd., Murrayville, Langley, B.C. C. E. Hope, Trustee, 614 Pender St. W., Vancouver.

**Leamington, Ont.**

Sketch plans are prepared for church to cost $15,000 for R. C. Congregation. Pennington & Boyde, architects, Bartlett Bldg., Windsor, Ont.

**Owen Sound, Ont.**

City Council plan alterations to City Hall. Chas. Gordon, Clerk.

**Stevensville, Ont.**

School Bd. No. 9, Twp. Bertie, plan to build addition to school.

**Tilbury, Ont.**

Community Hall costing $8,000 is being erected by R. C. Congregation. S. G. Kingsley, architect, Chatham, Ont.

**Welland, Ont.**

Erection of school is contemplated by School Bd. L. M. Mathew, secy., P.O. Box 47, Welland.

**White Rock, B.C.**

White Rock Methodist Congregation will erect church. Jas. B. Whitburn, architect, Westminster Trust Block, New Westminster, B.C.

#### CONTRACTS AWARDED

**Amherstburg, Ont.**

Contract for lathing and plastering for High School costing $65,000 for High School Bd. is awarded to W. Middledick, 583 Janette Ave.

**Burnaby, B.C.**

General contract for erection of school for Burnaby School Bd. is awarded to Weeden, Pierce & Deacon, 2015 Kingsway, West Burnaby, B.C.

**Cap de la Madeleine, Que.**

Steel contract for fire station costing $20,000 for City is awarded to Dominion Bridge Co., Ltd., Dominion Station, Lachine.

**Lemberg, Sask.**

Carl Bosleth, Lemberg, Sask., is awarded general contract for erection of school costing $6,000 for Weisenberg Separate S. D. No. 17, Lemberg.

**Montreal, Que.**

Roofing and sheet metal, and plastering contracts for church costing $50,000 for Temple Baptist Church, Bernard and Outremont Sts., are awarded to Richardson, Simard & Co., 745 Clarke St., and A. T. Clark, 745 St. Catherine St. W.

Contract for steel sash for addition to Montreal Jail has been awarded to The A. B. Ormsby Co., Ltd., Toronto.

Additional contracts for alterations to church costing $10,000 for St. Alban's Parish, are: Brickwork, Linfold Bros., care of gentral contractors, Graham & Windsor, 745 St. Catherine St. W.; roofing, Hickey & Aubut, 93 Dominion St.; plastering, A. T. Clark, 745 St. Catherine St. W.

**Ottawa, Ont.**

P. Ackroyd, 416 Bank St., has electrical contract for addition to church costing $6,500 for Holiness Movement, 5th Ave. and Monk St. Plastering contract is placed with Mr. Weatherdon, Bronson Ave.

**Quebec, Que.**

Jobin & Paquet, Engr., 28 Abraham Hill, have genieral contract for construction of 2 granite towers at cost of $60,000 on Ste. Foye Rd. for Rev. Fathers du St. Sacrement, Ste. Foye Rd.

**St. John, N.B.**

Jno. Flood & Sons, 109 Princess St., have general contract for repairs to St. Joseph's School costing $15,000 for Bishop LeBlanc.

**Springdale, Alta.**

K. T. Henderson, 2807 91st Ave., Edmonton, is awarded general contract for erection of school for Harmonien S. D. No. 3639.

**Toronto, Ont.**

Plumbing and heating contracts for school costing $150,000 for S. S. No. 26, York Twp., are awarded to Purdy Mansell, Ltd., 63 Albert St., Toronto.

General contract for erection of portable school for Upper Canada College, Lonsdale Rd., is placed with Goldie Construction Co., Ltd., 32 Church St.

**Wadena, Sask.**

General contract for erection of isolation hospital for Wadena Hospital Bd. is awarded to North American Lumber & Supply Co., Ltd., Wadena.

**Westmount, Que.**

Contract for interior woodwork for synagogue for Congregation Shaar Hashomayin is awarded to D. M. Long, 204 William St.

**Windsor, Ont.**

Electrical and plumbing and heating contracts for addition to Grace Hospital costing $150,000 for Salvation Army, 243 Dougall Ave., are awardtd to McNaughton-McKay Electric Co., 115 Sandwich St. W., and Robert Paddon & Co., 43 Sandwich St. E.

### Business Buildings and Industrial Plants

**Chandler, Que.**

Chandler Machinery Co., Chandler, are erecting a general bldg. at cost of $8,000. E. Jones, architect.

**Chateauguay Basin, Que.**

Erection of hotel at cost of $10,000 is

ESTABLISHED 1886

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## *Next Month's Conference of the Building and Construction Industries*

Frequent reference has been made in these pages to the forthcoming fourth annual conference of the Association of Canadian Building and Construction Industries in Hamilton, the dates for which are January 17 to 20. It will be remembered that this association was formed in the period of re-construction immediately at the close of the war with the idea of unifying, as far as possible, the various branches of construction activity in Canada. Much interest has been aroused by the activities of the association, and especially by the joint conference last May, of representatives of this association and of organized labor in the building and construction industry, which was called at the request of the minister of labor.

At the forthcoming conference it is expected that delegates will be present from all parts of Canada, for in spite of the depression which has existed many of the construction activities in our land, there is a feeling of hope that this will soon come to an end and a new era of activity will commence. It will be in this spirit that the conference will convene and discuss the problems which are bound to arise as soon as financial conditions become favorable for construction work.

A new feature of this fourth conference will be an exhibit of the products of the manufacturing and supply members of the association. The meetings are to be held in the large ball room of the Royal Connaught Hotel and space is being allotted around the walls of this large room and the gallery at the back for the exhibition of the products and advertising matter. The exhibit is in charge of the secretary of the Hamilton Association, Mr. E. B. Osborne, 36 James Street South and promises to be one of the successful features of the conference. This space is being provided for the manufacturing and supply members of the Association to exhibit their products without charge.

Another departure from previous conferences will be a greater emphasis upon the educational value of the sessions to the members. Arrangements are now being made for addresses by experts on some of the very practical questions which face the contractor and the sub-contractor in his endeavour to get business and to execute it without incurring a loss. It is also expected that there will be a speaker of outstanding importance who will give one or more addresses on some of the more economical aspects of construction followed by a round table discussion.

The daily luncheons, which have been such a pleasureable feature of the past conferences will again be held each day and programmes have been left in the charge of the Hamilton Association which means that there will be live and interesting speeches, community singing, and other special features. Time will also be given between the sessions for special entertainments and if the weather is favourable it is hoped there will be an afternoon of curling.

In addition to the general sessions a provision is made for special meetings of the general contractors, trade contractors and manufacturing and supplymen's sections to discuss their special problems.

Further announcements will be made as various arrangements are completed. A special appeal is made to all branches of construction activities in Canada to be represented at this conference. Room reservation should be made at an early date.

## *American Good Roads Congress to be Held in January*

Extended discussion by noted highway engineers from all parts of the United States and Canada relative to design, methods and materials used in modern highway construction will form a large part of the program of the American Good Roads Congress, to be held at the Coliseum, Chicago, Ill., on January 17-20 next, under the auspices of the American Road Builders' Association

Three of the eight sessions of the congress will be devoted to a discussion of new methods used in the building of asphalt, concrete, brick and other modern pavements. The economical construction and maintenance of the cheaper types, such as waterbound macadam, sand-clay, gravel and earth roads, will be discussed.

One session of the congress will be given over to the consideration of problems of highway finance and administration. Because of the high interest rates now prevailing on road bonds, approximately ten per cent. has been added to the cost of road construction from this source alone. Increased freight rates have added a like amount. Since many districts are fast approaching their permissable bonded debt limit, the methods of raising and expending road funds are becoming vastly important and road officials are bending all their energies toward securing greatest returns for expenditures.

Invitations to the congress are being sent to nearly 30,000 federal, state, provincial, county and city officials, contractors, engineers and business men in the United State sand Canada. It is expected that the

# The Outcome of the Printers' Strike

It is now six months since the publishers of the "Contract Record" and the majority of other publishers and commercial printers in Toronto went to the mat, so to speak, with the International Typographical Union. Frequent inquiries having been made by our readers as to the situation, it may not be amiss to review the various phases of the strike up to this date.

The Typographical Union may be said to be the Union de Luxe. The railroad labor organizations fade into insignificance when compared with this clever aggregation of United States officials which has endeavored to control the printing art. Yet their very strength proved their undoing. More men can stand up against adversity than against prosperity. So it would seem to be in respect to unionism. Arbitrary demands followed—virtually a closed shop, where no man could work peacefully unless a member of the union, the foreman controlled by the union, priority laws in respect to employment, etc. The wage demand was $44.00 for 44 hours —an increase in pay, a reduction in working hours, the combined factors making an increase of 36 per cent. in cost of production, which we were expected to pass on to our advertisers and subscribers. We refused to agree to their demands. What we will call Scene One closed with every man in our plant walking out on June 1st.

In the intermission, please read the following :

In the Book of Laws of the International Typographical Union, in effect January 1st, 1921, appears the obligation for members :

> "Article 12, Sec. 1 : All subordinate unions shall have an article in their constitution which shall read as follows : '......................that my fidelity to the union and duty to the members thereof shall in no sense be interfered with by any allegiance that I may now or hereafter owe to any other organization, social, political, or religious, secret or otherwise......................To all of which I pledge my most sacred honor.'"

The opening of the Second Scene found the men on the streets, picketing the plants, a few, perhaps, downcast because forced out by their Indianapolis officials, but the big majority of them beaming with contentment and decidedly "chesty" because of the assured victory in a few days, or a few weeks at most. And why not ? For, through the practice of closed shop rules, non-union compositors in Toronto were almost non-existent. But they overlooked at least three important points—the injustice of their cause; the moral influence against them when they attempted to show that "Might is Right," and the determination of the employers to conduct "open shop" in future. The first few weeks were strenuous. Getting a new organization together was a slow process. Our publications suffered to some extent, but our readers and advertisers everywhere gave commendation for the stand taken. The office staff turned in; some printers were procured from outside ; a few of the locals drifted back to their positions, and intensive training of apprentices was inaugurated. The employers, at a large expense, equipped a school for compositors and it was not long before they began to benefit by the product of this school. New pupils were sent to the school as rapidly as graduations were made therefrom, with the result that, without the assistance of the compositors who went out on strike, the 48-hour plants in Toronto are almost back to normal.

The tragedy occurs in the Third Scene, which is the present-day situation. The Indianapolis organization called out on June 1st something over 700 compositors from the Toronto employers who refused to grant their demands. To-day there are at work in the 48-hour "open shops" 604 compositors, and each day the number continues to grow. These shops represent about 80 per cent. of the total production of printing in the city. To these men permanent employment has been guaranteed as long as they perform satisfactory service. What, then, of the strikers ? Several hundred craftsmen out of employment and only a few positions at best. Misled by their leaders, living on day-to-day promises that the strike was about to end, encouraged by occasional bonuses to strengthen their morale, the rank and file have been kept in the dark as to the true situation. As the curtain drops, what do we find ? The "open shop" firmly established in the printing industry in Toronto ; the employers able to take care of their work ; the veil lifted from the eyes of the strikers, and the weaknesses of autocratic leadership revealed in a positive but painful manner. The Winter before the men and no work.

The fight of the publishers and employing printers in Toronto has been a fight for principles, a fight against arbitrary rule, a fight for right. It should encourage employers generally to stand out for the "open shop," which in substance means the right of every man to be permitted to work regardless of union affiliations.

Throughout the strike the "Contract Record" and other Hugh C. MacLean publications have appeared regularly, and, with the exception of some slight interruption at the outset, on time. Not an issue has been missed. The publishers are very grateful for the courtesies and consideration extended during this period.

*No. 72*

# *Canada's Engineers—A. A. Paradis*

**There is no branch of the engineering profession that carries with it such an opportunity for varied experience or that demands such a great measure of reponsibility as municipal engineering. Indeed, the successful city or town engineer has to exercise, in the course of his everyday work, an acquaintance with a wide variety of problems, not all of which are even engineering, but have to do with finance or other phases of civic administration. In large municipalities where the engineering requirments are departmentalized, engineers may specialize in one or two phases of municipal work, but in the smaller towns or cities where the amount of work is not sufficient to warrant segregation, the municipal engineer must be a man of all-round ability, having at his command a ripe knowledge and experience in many lines of engineering activity. On his shoulders rests a big responsibility and indeed, in many cities, he is the mainspring of municipal success. In recognition of the high place which municipal engineers hold, the Contract Record has, in this series, recorded the achievements of many outstanding Canadian city and town engineers. In this issue we have pleasure in adding another well known name in the person of A. A. Paradis, city engineer of Victoriaville, P. Q.**

**Mr. Paradis was born in 1883 and was educated in high school and under the direction of a private professor at Montreal. His engineering knowledge is largely a matter of practical experience, for he entered the service of the National Transcontinental Railway in 1904 as rodman and worked his way up through positions of greater responsibility during his ten years connection with that company, from 1907 to 1914 being engineer in charge of construction on that road. Since the latter date he has been consulting and city engineer of Victoriaville, carrying out in this capacity all the engineering activities of that municipality.**

Mr. A. A. Paradis

attendance will greatly surpass the record set last year and that the congress will develop a clearer understanding of diverse highway problems, so road officials may, in spending their funds, secure "more roads for less money."

## Winnipeg to Have the Next Annual Meeting of the Engineering Institute

The annual general meeting of the Engineering Institute of Canada will be held at Montreal on Tuesday, January 24, 1922, at ten o'clock a.m. At the meeting the formal business of the annual general meeting will be presented. The agenda will consist for the most part of appointments of scrutineers; appointment of auditors; reception of reports (a) of Council, (b) of Committees, (c) of Branches; new business; reports of scrutineers announcing election of officers.

The meeting will then be adjourned to Winnipeg, February 21, 22 and 23, where unfinished business of the annual meeting will be continued, and the annual general professional meeting will be held under the auspices of the Winnipeg branch. The program of the professional meeting, details of which will be announced later, is at present under consideration by the Winnipeg branch.

The Winnipeg branch anticipates and is providing for a large attendance, and it is sincerely hoped that many members both east and west of Manitoba will plan to be present. It is expected that special arrangement will be made for a train from the east and possibly from the west coast for those attending the meeting.

## Toronto Engineering Firm Expands

Editor, Contract Record:

In the last number of the Contract Record you have listed, under Trade Incorporations, "Frank Barber & Associates," to carry on the business of civil and structural engineers. The firm has hitherto been known as Barber, Wynne-Roberts & Seymour. I wish to give the reason briefly for the change in the name of our firm. My associates, Mr. Wynne-Roberts and Mr. Seymour, are remaining with the firm, without any change in their relations to it. We have, however, been adding new departments and propose to leave ourselves free to add others, and the heads of these departments will be men of experience and capacity well known in their own lines. We were, therefore, faced with the problem of either inserting the names of all our associates, making the firm name rather too long or leaving some of the names out. We decided, therefore to leave all the names out of the title except one. We should have preferred to have no individual name in the title, but there seemed to be no precedent for this amongst firms of professional men. I need not mention the reasons that influenced us in applying for incorporation. Of late years the business of the firm and the consequent responsibility has become too great to be readily handled except under the provisions of the Companies' Act.

Yours very truly,
Frank Barber.

# Hydro Commission Suggests Schemes for Developing St. Lawrence Power

## Three Plans Presented to the International Joint Waterways Commission for Consideration—Recommended Scheme is a Two-Stage Development, Providing 1,600,000 Horse Power

The report of the engineers of the Hydro-electric Power Commission ot Ontario, before the International Joint Commission, which has just been presented and discussed before that body, brings home to Canadians in a very forcible way the almost incalculable value of the water powers of the St. Lawrence River. We have been taught to look upon Niagara Falls as the greatest power centre in the world and yet, in the St. Lawrence we have development possibilities equal to more than twice those of Niagara Falls, and, so far as may be judged by a study of the estimates, the cost of development will certainly not exceed that of present-day development at the latter site.

Roughly speaking, the water power possibilities of the St. Lawrence River may be divided into three separate sections:

(1) From the head of the Galops Rapid to the foot of the Long Sault Rapid, that is, approximately, from Prescott to Cornwall, including the Galops and the Rapide Plat, a fall at Farran's Point and the Long Sault,

(2) From the head of the Coteau Rapid to the foot of the Cascades Rapid, and,

(3) From the head of the Lachine Rapid to Montreal Harbor.

These three reaches are separated by two river expansions, known respectively as Lake St. Francis and Lake St. Louis.

In the upper reach, which covers approximately a distance of 60 miles, there is a total fall of a little over 90 ft., 80 or 85 ft. of which can be utilized for power development.

The middle reach, lying between Lake St. Francis and Lake St. Louis, about 15 miles in extent, includes three rapids, the Coteau, Cedars and Cascades. The total fall is about 82 ft. of which it is estimated 75 ft. can be made available for power purposes.

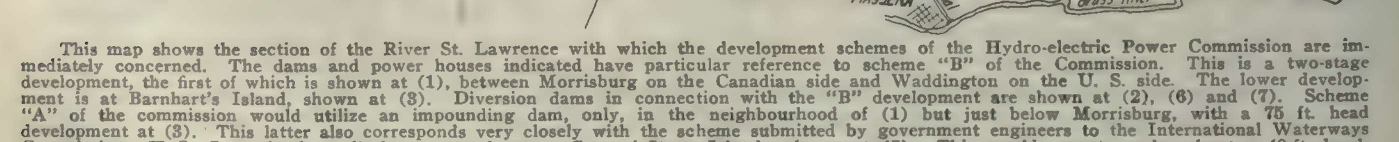
In the third and lower reach, between Lake St. Louis and Montreal Harbor, the total fall, including the Lachine Rapid, is about 45 ft., of which 30 to 35 ft. it is estimated, can be made available for power development.

The total power, therefore, in the three rapids amounts to in the neighborhood of four million horsepower, of 24-hour power. Of this, about 1,600,000 may be apportioned to each of the two upper reaches and half that amount to the third and lowest reach. Only about 300,000 h.p. has been developed on the St. Lawrence River up to the present time, of which about two-thirds is on the Canadian side.

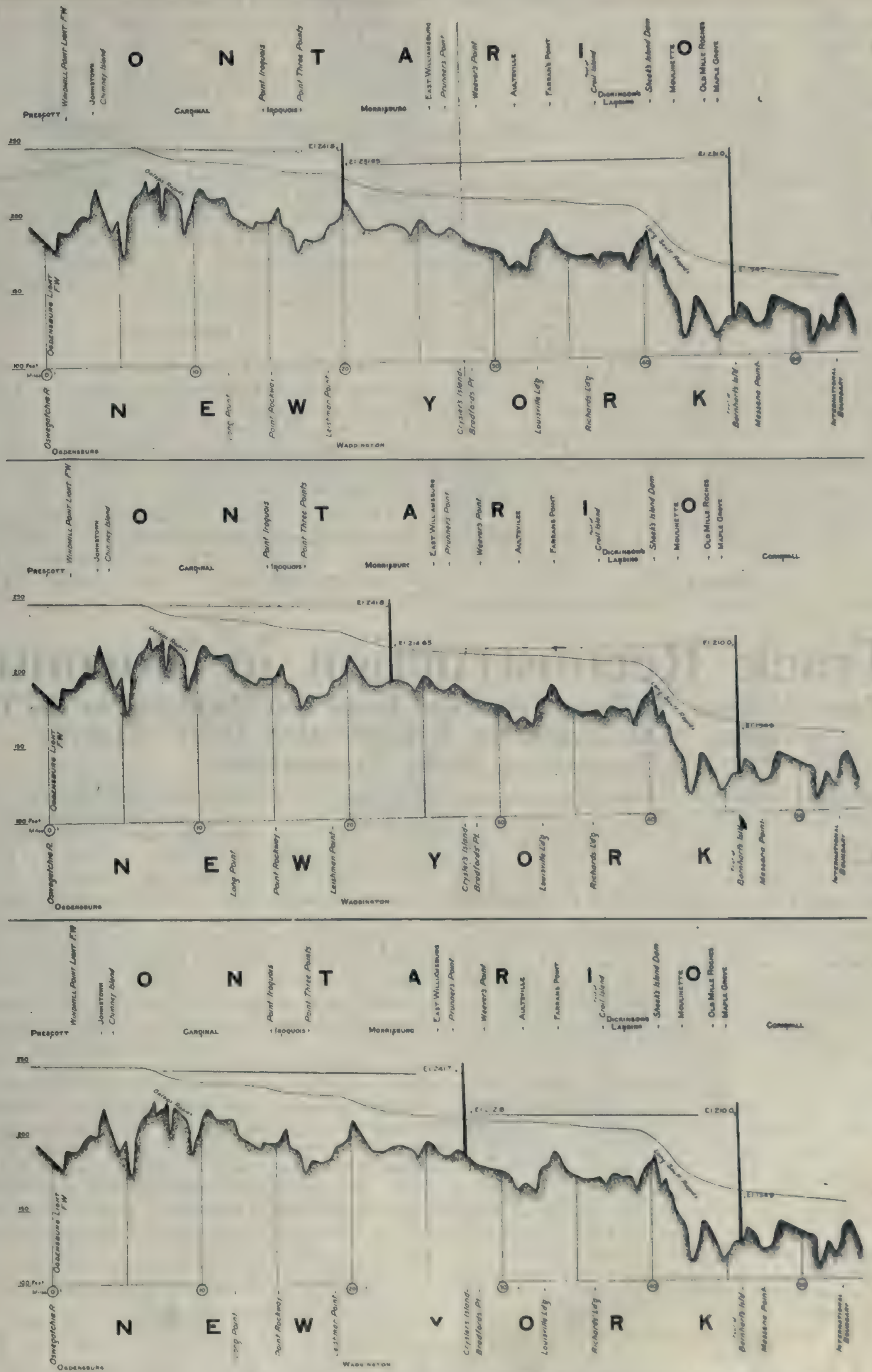
The two lower reaches outlined above are entirely within Canadian territory and, as such, do not fall within the jurisdiction of the International Waterways Commission. The present discussion, therefore deals entirely with the development of the upper reach, namely, that between Prescott and Cornwall. It will be recalled that a report was recently made by government engineers, acting for Canada and the United States, covering a plan of development of the upper reach. This made provision for an impounding dam just above Morrisburg, where there would be a fall of 8 or 10 ft. and located the main dam at the foot of the Long Sault Rapids with a fall of about 75 ft.

Hugh L. Cooper & Company also recently prepared a report for the International Joint Commission. This report made provision for the development of the upper rapids only of the first reach, locating the power house at Steen and Cat Islands, just opposite Aultsville, a few miles below Williamsburg and Morrisburg.

Both of these schemes had the disadvantage that they flooded very valuable and very considerable areas on both sides of the river, which would either result in the destruction of the towns or necessitate the erection of high, expensive dykes. The town of Morrisburg is an example, as more than half of this town, and the most valuable half at that, would be submerged by these schemes. Mr. Cooper's development



This map shows the section of the River St. Lawrence with which the development schemes of the Hydro-electric Power Commission are immediately concerned. The dams and power houses indicated have particular reference to scheme "B" of the Commission. This is a two-stage development, the first of which is shown at (1), between Morrisburg on the Canadian side and Waddington on the U. S. side. The lower development is at Barnhart's Island, shown at (3). Diversion dams in connection with the "B" development are shown at (2), (6) and (7). Scheme "A" of the commission would utilize an impounding dam, only, in the neighbourhood of (1) but just below Morrisburg, with a 75 ft. head development at (3). This latter also corresponds very closely with the scheme submitted by government engineers to the International Waterways Commission. H. L. Cooper's plan calls for a power house at Cat and Steen Islands, shown at (5). This would operate under about a 40-ft. head. Scheme "C" of the Ontario Commission, which also calls for a double development, locates the upper power house at Chrysler Island, shown at (4) and the lower one at Barnhart's Island. The diverting dam shown at (6) could also be utilized to develop a certain amount of power under about 29 ft. head, with either of the single development schemes.



Profiles of schemes A, B and C, respectively of the Hydro-Electric Power Commission for development of power on the St. Lawrence River.

plan did not take into consideration the immediate utilization of the Sault Rapids.

The Ontario Hydro engineers studied the question from a number of angles and finally submitted three plans, known as "A", "B" and "C". Of the three plans submitted, however, they considered plan "B" as the most satisfactory.

### Scheme "A"

There is comparatively little difference between scheme "A", as submitted by the Hydro-electric Power Commission of Ontario, and the scheme of the government engineers, recently submitted to the International Waterways Commission. Provision is made for a control dam in the neighborhood of Waddington, N. Y., a short distance higher up the river than Morrisburg and the power house would be located at Barnhart's Island, at the foot of the Sault Rapids. At this point there would be an available head of 74.5 ft. It will be seen that this plan is open to the disadvantage mentioned in connection with the other two. About 29,000 acres of valuable settled land, including towns and villages would be destroyed unless expensive dykes were erected to protect them. Further difficulties arise in connection with the necessary ship canal. The total development at this point would be 1,492,000 h. p., at a cost of $141,700,000.

### Scheme "B"

Scheme "B" represents a two-stage development. In the upper would be included the Galops Rapid and the Rapide Plat; the lower would include the fall at Farran's Point and at the Long Sault. The upper power house would be located on Ogden's Island and the lower one on Barnhart's Island. The fall at the upper dam would be 27 ft. and at the lower 54.5 ft. The total development would be 1,600,000 and the cost $154,100,000.

The advantage claimed for this plan is that the area flooded would be much less, only about 6,000 acres; more power to the extent of something over 100,000 h.p. would be made available; also, on account of each of these developments being a smaller proposition, power could be made available in much less time from the upper of these two plants.

### Scheme "C"

Plan "C" is also a two-stage development, the upper dam and power house being placed at Chrysler's Island and the lower power house at Barnhart's Island. This plan would involve the flooding of very considerable areas, including the town of Morrisburg and it is understood the commission does not look upon it with particular favor.

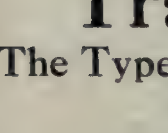
The profiles shown herewith will give our readers a sporting insight into the different schemes of the Ontario Commission. The map indicates the location of the dams and power houses in scheme "B" of the Ontario Commission.

# Track Reconstruction in Toronto

## The Types of Street Railway Track and Road Bed Employed by the Transportation Commission in Rehabilitation Work—Heavy Concrete or Stone Foundations

In the Contract Record of November 23rd, pages 1009 to 1014, there appeared a very extensive article descriptive of the construction activities of the Toronto Transportation Commission. The various operations involved in the rehabilitation of the street railway tracks of the city of Toronto were outlined and explanation given of the organization that had been developed to take care of the construction program. While the general principles of design adopted by the commission in reconstructing tracks and road beds were described in the previous article, supplementary information will be presented in our pages in future issues in order that the scheme may be quite clearly explained. The present article illustrates the composition of the different types of foundation work.

The track and road bed rehabilitation follows one or other of two general plans—(a) a concrete foundation; (b) crushed stone foundation. On foundations of the second ›e, granite block pavement only has been used, while on ete slabs, either granite block paving or asphalt has pted, although the asphalt is in general merely a substitute for granite blocks. Inability to secure terial, on time, for all the track reconstruction mpelled the commission to adopt asphalt. This ɔ as it wears out and replaced by a more durvement, provision being made for this con- ial construction, as described below.



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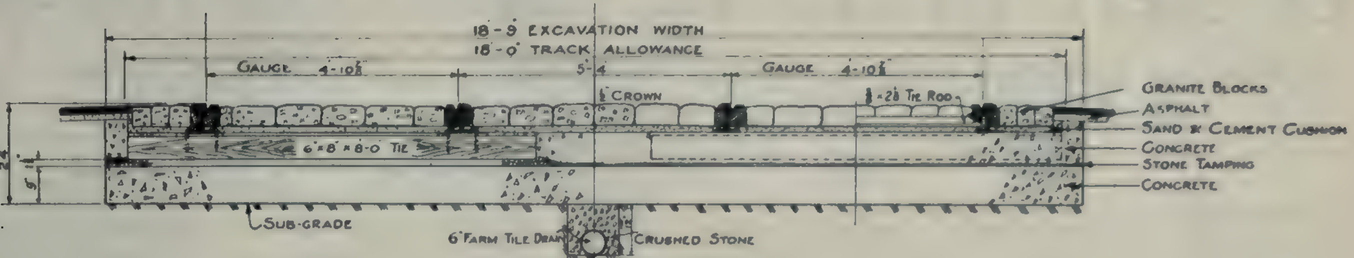
h have been adopted are 122 lb. grooved sections, although in certain instances, 100 ections have been employed. These rails r jack pine ties, 8 ft. long, 6 in. thick and 8 in. wide, and spaced at 2 ft. centres, standard tie plates being used if the ties are of soft wood. The whole track is then carried on a concrete or crushed stone foundation.

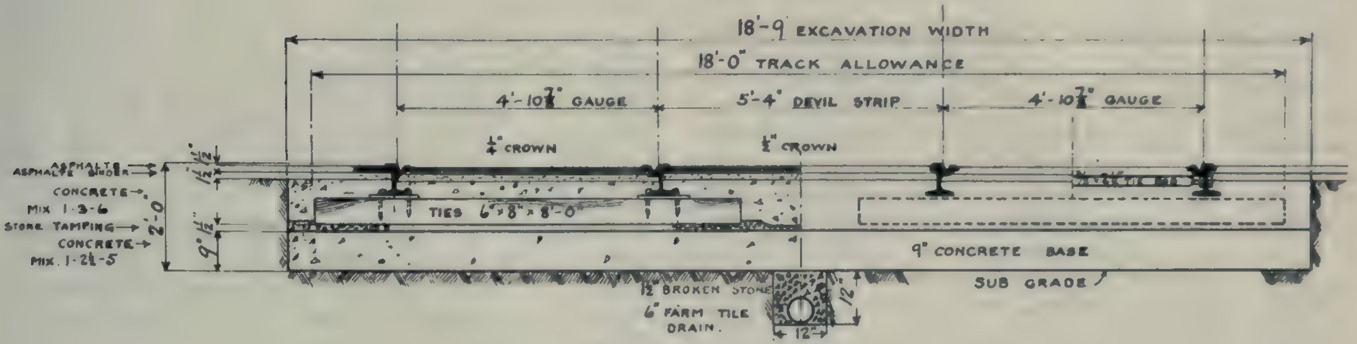
The excavation for the tracks is carried out to a depth of 2 ft. below the top of rail, and a width of 8 ft. 6 in. for single track and 18 ft. 9 in. for double track. Except in cases requiring special attention, under drainage is secured by a line of farm or bell-mouthed tile drain laid in the centre between tracks in a trench 12 inches wide by 12 inches deep, filled to sub-grade with clean 1½ in. stone. The foundations consist of either a 9-in. slab of 1:2½:5 concrete with trap rock aggregate, or 9½ in. of crusher run with a maximum of 2 in. stone. The former type of construction has been generally adoptel for tangent track, while the latter has been employed on all intersections, and on certain minor portions of other track where sub-grade conditions were considered to be suitable. Over this foundation slab is applied 1½ in. of cushion material consisting of a mixture of 60 per cent 3/8 in. crushed limestone and 40 per cent of stone dust. This course is well tamped by hand or pneumatic tools to bring the track to true grade. Its primary purpose is to give resilience to the construction but it has a seconary advantage in the concrete base construction in forming a mechanical separation between the foundation slab and the paving base, thus enabling the tracks to be renewed without interfering with the foundation slab at all.

The paving base consists of 1:3:5 concrete with crushed limetsone or gravel as the coarse aggregate. This is carried up to the grade of the base of the paving. In cases where asphalt paving is adopted, the paving base is poured in two

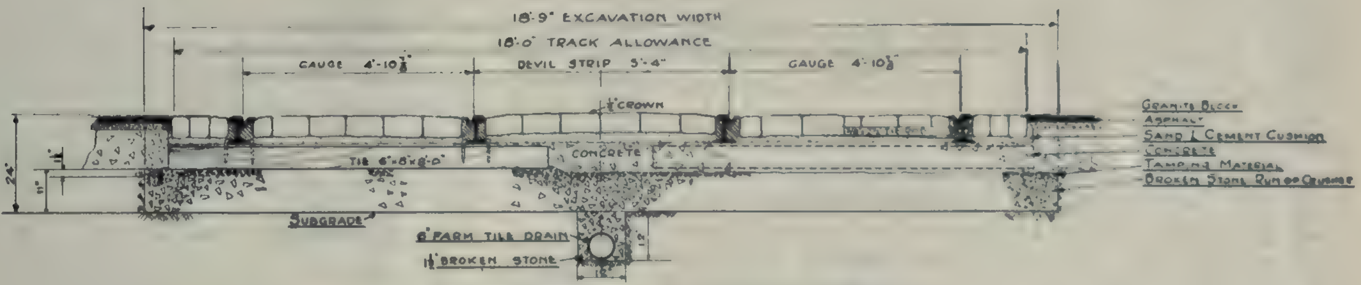
# Types of Construction for Track Rehabilitation in Toronto



Concrete Base with Granite Block Paving



Concrete Base with Asphalt Paving



Crushed Stone Base with Granite Block Paving

courses, the bottom course being allowed to stand for a day before the top lift is poured. This will make it possible to chip off the top course more easily when the asphalt wears out and it is desired to replace it with granite blocks. The granite blocks are laid on a cushion of cement and sand and are grouted with cement grout.

The gauge of street railway tracks in Toronto is 4 ft. 10 7/8 in. and on double track construction the commission is laying the tracks to 10 ft. 2 7/8 in. centres, giving a 5 ft. 4 in. devil strip. The rails are laid with joints opposite, whether single or double track. They are tight-butted and the joint plates are welded to the rails along the top and bottom. Tie rods are inserted every six feet.

The track work of the Toronto Transportation Commission is under the direction of A. T. Spencer, engineer of way.

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## NEW CONTRACTOR IN GALT

Mr. A. C. Troup, 88 Spruce St., Galt, Ont., has just started up for himself in the contracting business. Mr. Troup would be pleased if manufacturers and others interested would send him their catalogues and price lists.

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**The popular feeling among building supply dealers seems to be that prices, generally, have a tendency to lower levels, and not up as some authorities would have us believe Mr. Lavelle, of Rogers Supply Company, Toronto, prominent building supply dealers, in conversation with the Contract Record recently, stated that he thought further declines could be looked for before the opening of the construction season next spring, which would considerably stimulate the industry next year. True, there have been instances where certain materials have shown a slight advance recently, but these have been isolated and, for the most part, apply to materials that do not vitally affect the building industry. Price revisions on lumber, steel, cement, lime and several other important construction materials during the past few months have been downward, this tendency being particularly noticeable in the case of the first two items mentioned.**

# Design of Long Span Bridges

## Famous Designer Outlines Some Principles to be Considered in the Planning of Large Arch and Suspension Structures—Architecturally Pleasing as Well as Structurally Sound

The definite assurance that the new bridge from Windsor, Ont., to Detroit, Mich., will be started almost immediately makes it timely to give some thought to long-span bridge design, for the new Detroit River structure will be one of the outstanding bridges on account of the span which it will have. It is for this reason that we reprint herewith, slightly condensed, a paper by that noted bridge engineer, Gustave Lindenthal, which was presented at a recent meeting of the Philadelphia Section of the American Society of Civil Engineers. This meeting was called to discuss the new Delaware River suspension bridge which will be one of the longest span structures in the world. In Mr. Lindenthal's paper, some thoughts are presented which are worth some serious consideration as coming from an engineer of many years attention to the art of bridge building. Mr. Lindenthal has designed some of the most famous bridges in the world and his arguments will, therefore, carry great weight.

Every unusually large bridge project offers new problems of construction, and it is a laudable although infrequent practice to offer up the plans for discussion by engineers before they are carried out. In this wise more or less valuable views and experiences on the subject may be exchanged or contributed that may be of benefit to the project and so also to the whole profession.

Any large bridge should be designed with a view to fine architectural appearance. That much at least is due to a civilized age and it is particularly important in a city bridge. Every large bridge, even when it is unsightly, has a monumental character from its very hugeness, and causes wonderment. But it should do more than that: it should also give the beholder a feeling of pleasure and enjoyment. That is the essence of architectural art, and the more perfectly it is attained the greater the merit of the work and the greater the regard for the sciences and the arts and for their disciples, who create and leave it to posterity as a proof of culture and progress.

### Cantilever and Arch Bridges

A cantilever bridge is the least adaptable to artistic treatment, but a large span can be given an imposing architectural appearance by the thoughtful engineer, through choosing a pleasing silhouette and through adroit differentiation of the bridge members so that they will express in their form and massiveness the forces they resist. A satisfying aesthetic form for a very long cantilever span as in the Delaware river bridge would, however, require the arching of the lower or compression line of the superstructure below the line of roadway, as was done in the two large spans of the Firth of Forth bridge in Scotland, having about the same length as the river span in the Delaware bridge. In the well-known Quebec cantilever bridge, the bottom edge of the structure also descends below the floor line but unfortunately in straight lines, thus giving the bridge an amateurish appearance and unnecessary ugliness. It is regrettable that the graceful lines of the first Quebec cantilever design were not retained, because it was in its outlines and conception a meritorious design, but collapsed under its own weight; not enough metal had been put into it.

An arch bridge is the next in aesthetic value. From arch designs of nearly 3,000 ft. span (over the Straits of Messina) worked out in considerable detail, it is known that arch bridges of very long span offer decided advantages over cantilever bridges, where the shores offer good abutments. But in the case of the Delaware river bridge, for which the government required unobstructed width above the river, it was plain from the first that some type of suspension bridge would best satisfy local conditions. No time should have been wasted on a cantilever design.

It was then a question what kind of suspension bridge. One should think that nearly any kind of suspension bridge would satisfy aesthetic demands, because the graceful curves of suspended cables, nature's beauty line, could not be spoiled by the callousness of man. But that such can be the case, was the experience in the Williamsburgh bridge, the second bridge built over the East River. No architect was consulted in the shaping of the bandy-legged towers or in the clumsy anchorages, nor were the stiffening trusses made sightly with any thought of forming a harmonious combination with the cables. The result is an unnecessary ugliness which even the untutored mind beholds with surprise. That structure has the distinction of proving how unsightly even a suspension bridge can be made if you try.

### Make Towers Monumental

It should be the aim of the bridge architect designing a large suspension bridge, especially in city surroundings, to emphasize its monumental character in its most prominent feature, that is, the towers. They should satisfy the innate desire to give dignity to the structure. It has found expression in all larger suspension bridges, some of them built a century ago. Stone was invaiably used for the towers. To this fact all the old supension bridges owe their reputation for beauty, whether it was of the rugged kind as in the early English and American structures or of the more refined and ornamental kind as in some of the Continental suspension bridges.

The Brooklyn Bridge, completed 38 years ago, was the last suspension bridge with stone towers. The explanation is simple. High stone towers for very long spans are heavy and require big foundations, which are costly when they must be placed under water on deep rock. Metal towers are lighter and cheaper. But up to fifty years ago, cast iron was the only metal that could have been used as a substitute for stone towers and that only for limited heights. Only after the iron rolling mills became capable of producing heavier rolled shapes was it feasible to fabricate large metal towers of rolled iron and steel to take the place of stone towers. The designing of large metal towers as an art is therefore rather young, and only a few good examples of artistic metal bridge towers exist in smaller bridges.

From the aesthetic point of view, metal towers, no matter how finely designed, will never equal stone towers. The finest example of an artistic metal tower is the Eiffel Tower in Paris, which carries no load but its own weight. And yet as an architectural creation it does not impress the beholder with that feeling of dignity and majesty which he experiences at the sight of any of the great spires in famous cathedrals. Although the highest inspiration of the architect as also the cunning skill of the artisan will probably always prefer stone to metal as buildingg material for monumental work, the modern architect is obliged to also use steel and iron. He must create his own precedents in that material, and a large suspension bridge is one of the occasions for it.

The writer held this view when, as Commissioner of Bridges of New York, he took charge of the East River bridges, nearly 20 years ago. But he found that he could do nothing in that respect during his short term of office. The Williamsburgh Bridge was building, the steel towers and anchorages were completed, the cables and its superstructure were contracted for and in process of erection. For the Manhattan Bridge the narrow tower foundations were already sunk. Such was the case also with the Queensborough Bridge. The revised designs for all these bridges were fitted to conditions that could not be changed. These designs were either mutilated or thrown away by succeeding administrations involving a loss of many millions of dollars.

### Beauty and Utilitarianism

Particular effort should be made to design the metal towers of a large suspension bridge on artistic lines. The engineer who thinks merely of stresses must combine with the architect, who deals with artistic forms. The thousand-foot Eiffel Tower already mentioned may illustrate the point. When in a discussion with a prominent structural engineer he had pointed out to him the beautiful lines and elegant details of that great metal shaft as a fine example of French artistic skill, it was not a little surprising to hear him denounce that structure as wasteful, exhibiting poor engineering of which no American engineer would be guilty. In fact not long after, an American design, a typical shop-creation, for a very high steel tower was published as an example of what such a structure should look like. Ugliness is rational beauty to minds who see merit only in geometrical figures, and in cheap fabrication. It is not unusual for an engineer to be derided by his fellow engineers as wasteful and unscientific if he uses a few extra pounds of metal or a few extra yards of masonry to make his structure more durable or more sightly. If such notions prevail, we may ask ourselves, of what effect are our boasted academies of art and schools of architecture? We have no record of any such institutions existing for the benefit of the architectural geniuses in Greece and Rome, or among the god-inspired medieval cathedral builders of Europe, or among the ancient Babylonian, Indian and Moorish architects, whose wonderful work compels our admiration to this day. We know that they did not get their inspiration from dry mathematical formulas, for they had very little of such knowledge, but they all had in them a spark of that creative supreme force and mind which molds and directs the universe and with it that innate love for the beautiful which like a flame tends ever heavenward. The fine arts, which include architecture, will forever remain the true measure and index of human progress and intelligence. Future generations, wiser than ours, will judge our civilization by its achievements in monumental contructions, and for this reason we should feel it as a solemn duty and an obligation to the community to do our best in that field.

Steel towers should have at least four columns to express stability and power and should have a form and bracing for which the French school of architecture, for instance, furnished fine examples of artistic treatment in the buildings of the Paris International Exhibition in 1900. From designs studied in that manner a choice could be made that would testify to the pride and good taste of opulent cities just as some of the beautiful bridges in Paris and London do for those cities.

### Foundations Often Too Narrow

Such towers, provided with stairways or elevators to make the top readily accessible to visitors, would require a wider base, but not necessarily a more expensive foundation nor would they cost much more more than the proposed towers. They would give the bridge its true monumental character and take it out of the commonplace. The towers should be fully designed and considered before the foundations for them are commenced. Because if the proposed narrow foundations were commenced, it would make the designing of more beautiful towers impossible. This happened in the case of the Manhattan Bridge (of which the proposed structure is an imitation), where the narrow foundations prevented a design for monumental towers and a wider bridge. This bridge only a few years old, is already too small, so that it is used only as a one-way bridge in rush hours mornings and evenings. So is also the old Brooklyn Bridge.

As the high anchorages for the Delaware Bridge will be visible from a long distance on the river and from the shores, their silhouette and architecture should be fitted to that of the towers. That applies of course also to the suspended structure. Each has its proper share in the harmonious whole of a monumental bridge. The dominating feature however, will always be the towers.

### Construction Details of Suspension Bridges

Wire, because of its greater tensile strength than bars or rods, found early use in suspension bridges. French engineers (Dufour in 1823 at Geneva) were the first ones to use it, while English engineers (Telford in 1820) had a preference for chains of iron, in the form of forged eyebars. The difficulty found in straining the wires to uniform tension made the French engineers cautious, and so they preferred the method of construction which consisted in composing the wires into strands of parallel wires (occasionally also in the form of wire ropes). They were made on land. The strands hung side by side in vertical planes. The suspenders hung from crossbars on top of the strands and were lashed to them. This was also the construction of the first wire suspension bridge (1,100 ft. span) built over the Ohio River (1846) at Wheeling by the French engineer Ellett. The twelve strands for it were completed on land and hung on the towers. Shortly after its completion, a tornado turned the bridge upside down. John A. Roebling, who had already built a few smaller wire bridges, repaired the Wheeling Bridge. He disentangled the strands, and compacted them into two cables. Corroded wires in the anchorage were cut out and replaced. The bridge is kept in good condition and is still in use, while most of the early wire bridges in France broke down from neglect and corrosion.

Roebling subsequently introduced the method of spinning the cables in the air and compacting the wires into cylindrical form by wrapping them with a continuous softer wire. This was the method followed in most American wire cable bridges. Only for two wire cable bridges over the Ohio River (at East Liverpool and Portsmouth) were the strands for the wire cables made on land.

All the early suspension bridges everywhere were built with flat catenaries, to which they owed their comparative rigidity in the absence of adequate stiffening frames to prevent undulation in the cables and chains from loads and wind. To the flat catenary (with a deflection of one sixteenth to one thirteenth of the span) must also be ascribed the success of air spinning and compacting the wires under nearly uniform tension into solid cables, so that loose wires in them were rare and, in small cables, easily discovered and rectified. The last cables with flat catenaries, one thirteenth of the span, were those of the Brooklyn Bridge. The wires were laid up on a still flatter catenary than that of the finished cables, by moving the saddles on the stone towers toward the anchorages and thus increasing the tension in the wires during erection of the cables; this method was a great help to the better adjustment of tension in the wires before they were compacted.

### Time for Completing Cables

The four Brooklyn Bridge cables, each 15¾ in. in diameter, were completed in 21 months. The next large cables, in the Williamsburgh bridge, with about one ninth deflection, were finished in 7 months, and the wire cables in the Manhattan Bridge, with one eighth deflection, were finished in four months. The successive shorter finishing times indicate the progress made in rapidity of cable construction, but it is a moot question whether the quality of the cables, as regards evenness in tension of wires, is as good in the latter as in the Brooklyn and earlier bridges.

Many loose wires near the towers were observed during the compacting of the cables in the Williamsburgh Bridge, and they occurred also in the Manhattan Bridge. The compacting and wrapping machines, starting from the middle and working toward the towers, compact the carefully laid wires so tightly that it would be impossible to pull out a single wire from the compacted portion only a few feet long. Loose wires can be adjusted in length only by cutting them and inserting a little turnbuckle splice, with which to tighten the spliced wires if possible to the same tension as the other wires. The trouble is, however, that with all possible care in laying the wires, each adjusted in length with the guide wire, their length is constantly changing from changing temperature conditions in open-air work exposed to sun and winds. There always occur wires a few degrees warmer than others, producing local differences in tension and position in the same wire when in part already gripped in the compacted cable. The compacted wires canot slide on each other between the bearings on the towers, where they are held fast by their pressure. So the wires with less tension are forced together and compacted with those of higher tension. But where the wires are not yet confined and compacted, they will bulge out, particularly as the compacting machines are nearing the towers. If the tension in the parallel wires at any one section of the cable differed even as much as 25 per cent, it would mean no more than that some wires are stressed more than others, but that on the whole they are pulling together. The modulus of elasticity for the cables would of course be much lower than for the simple wires, but in the aggregate the entire cable section may have a sufficient margin of strength and safety. If the unequal tension in the wires can be controlled and kept between certain limits by careful work in the compacting of the cables, the total effective elastic strength of the cable, the only thing that counts, will be lowered, but still will be high enough to include maximum stresses from loads and temperature. But this condition can be attained by simple methods only in smaller cables, in which the loose wires can be discovered and adjusted. As the diameter of the cable and the number of wires increase, such adjustment becomes increasingly difficult if not impossible.

### 21 Inch Cables the Limit

The cables in the Manhattan Bridge, 21 in. in diameter, may be considered as the limit of size for such work, and it is not at all certain that the limit for safe air work was not then already exceeded. There exist no reports on the condition of the cables, during erection, except the observation of many loose wires forced into position by the compacting machines. If large cables, before being compacted, could be uniformly loaded with a large part of the suspended load, which would produce in the wires between bearings greater tension and stretch than that due to their own weight plus the elongation from the highest summer temperature, and allowed to slide freely upon each other during their elongation, and then compacted in that condition, each wire inthe cable between bearings would be under uniform tension although the many wires may differ slightly in tension one with the other. The aggregate strength of the cable would be brought nearer to the theoretical strength, which is equal to the sum of the wires. This method would require special preparation and would obviously be costly and slow. A less effective alternative method would consist in starting the compacting machines on the empty cables from each tower down towards the center and ends, instead of the reverse, which latter is the accepted practice. The bulging of loose wires would then occur in the middle of the river span and near the anchorages instead of near the towers. Their adjustment and resplicing would occur at those parts of the cable where they have a surplus of strength and so would be less harmful. But the difficulty, if not impossibility, of reaching loose wires in the interior of a large cable would remain.

Thus, we do not lack methods and means for making large wire cables of reliable strength, if they have to be made irrespective of cost, and if we have enough faith in their durability, which is not however justified to the extent of believing them as durable as eyebar chains. The engineer should prefer that construction which for the same money is the best and affords the greatest permanence.

### Prevention of Corrosion

This leads to the subject of maintenance of cables. The best practice to preserve the wires against corrosion is undoubtedly galvanizing, i. e., covering them with a zinc coating. That practice was followed in the Brooklyn and Manhattan Bridges, but not in the cables for the Williamsburgh Bridge. The wires here were covered by a thick mineral oil paste expected to fill the interstices between the wires to make them water- and air-tight. That expectation was not fulfilled. Moisture condensed from the air penetrated the interior of the cables, which are enclosed in thin steel mantles. Corrosion started and repairs became necessary within a few years. Thick white lead paint filling up all hollow spaces is the best protection for that purpose.

But there is nothing permanently perfect in this world. As the zinc covering of wires may in the handling of them become abraded in spots and leave bare spaces, protection cannot be absolute. Some accidental stray electrical current may find the weak spots and by electrolysis start corrosion where it cannot be known or got at. In this connection we must keep in mind that the great strength of the wire is in the outer layers of metal near the surface which is the reason why small wires are proportionately much stronger than large wires. If the surface corrodes away, the wire breaks easily. Several French suspension wire bridges hardly twenty years old fell down, some 60 to 70 years ago, one after another, rather suddenly, because there had been neglect in painting. The outside painting of cables of course cannot stop corrosion inside and hold up a bridge. We see plain fence wire after a few years literally disappear like dust, particularly in smoke-laden air. Galvanized wire will last longer but when corrosion does get a start, the wire seems to vanish even faster than plain wire. It is so with tin roofs and tin cans.

The writer had been a strong advocate of wire cables for large suspension bridges for many years. They appeared to be an ideal method of construction for very long spans at lower cost than other bridge types. But when on closer study and observation he discovered the practical difficulties arising from greater span and larger size of parallel wire cables, he came to the same conclusion as other observing engineers, among them the late Geo. S. Morison, certainly a high authority. In his paper, (A.S.C.E., Vol. XXXVI, 1896) on a study for a large suspension bridge, Mr. Morison had chosen for his 30-in. cables coiled wire strands, finished in the shops to accurate length and submitted to a proof-stress before erection, as preferable to cables with parallel wires.

### Chains for Suspension Bridges

The writer had about the same time examined into the practicability of fabricating wire links, (to be enclosed in a roomy shell of noncorrodible metal), with which to compose chains for suspension bridges. His first design for a suspension bridge at Quebec (1899) included that construction. The links were to be made of rectangular wire with corners rounded off, each link submitted to a proof-stress. They were guaranteed as to strength and quality by the large wire firm of Felten & Guilleaume of Cologne. There would have been absolute certainty as to the strength of chains of this construction. This same firm as well as other firms manufacture several forms of patented coiled wire cables, which have been used in suspension bridges of moderate span with great success. These were at first proposed also for the new Budapest suspension bridge in 1894. But the engineers for that bridge decided finally, after, long deliberation, in favor of chains of eyebars cut out of wide plates. There are no plants in Europe for making forged eyebars. The finer architectural appearance of huge eyebar chains and their greater durability were the final deciding factors.

The questionable condition and apparent uncertainty of strength of the large wire cables in the Williamsburgh Bridge induced the writer, as Commissioner of Bridges for the city of New York, to avoid large wire cables in the plans for the Manhattan Bridge. The design provided, therefore, for chains of forged eyebars of nickel steel, which appeared to have many advantages over chains of wire links. That design was submitted to a board of five eminent bridge engineers and approved by them. Their report has been published (Trans. A.S.C.E., Vol. LV, 1905, pp. 89-93, Report by Geo. S. Morison, C. C. Schneider, Mansfield Merriman, Henry W. Hodge, Theodore Cooper). In comparing chains and wire cables their first report to Mayor Seth Low set forth:

The chains have decided advantages in the accessibility of all parts for inspection and protection as well as in economy and rapidity of erection. They are to be preferred to wire cables whenever the cost of chains is not materially greater. The cost of eyebar chains and wire cables in this bridge would be about the same.

In their final report they said,

We deferred our final report, relating to the quality of the material to be used for the eyebar cables, until additional tests could be had and we should be satisfied by correspondence with the leading manufacturers of structural steel, that the desired material could be obtained at reasonable price and in open competition. In our preliminary report, March 9, (1903), we reported favorably on all features relating to the design of this bridge, subject only to the uncertainty of obtaining this quality of material. This uncertainty is now removed. In this final report, we unanimously recommend the adoption and execution of the proposed design of the Manhattan Bridge, as submitted to us by the Commissoner of Bridges.

The reason why the Manhattan Bridge was not built on the approved plans is well known. Before the contracts could be let, another city administration was elected, which also changed the management of the Bridge Department. The approved plans were thrown away, and new plans were made for a wire cable bridge, costing several million dollars more than the chain bridge. No board of engineers was called in to report on these plans, or compare them with those already approved. The character of bridge management can be judged from the fact that the courts were appealed to by outwitted bidders to stop fraud in awarding contracts on manipulated bridge specifications. That a management of this kind would be very much concerned about the quality of the work or about progress in the art of bridge building was not to be expected and it for this reason that we are without reliable scientific information or records on many details of erection and maintenance of the East River bridges of that period. Among these are the actual condition of the big wire cables, erected in the unprecedented short time of four months, a very creditable performance, provided it was not at the cost of quality.

### 30-In. Wire Cables Big Advance

In any event there is no reliable basis or safe precedent for a leap from 20-in. cables to 30-in. cables with parallel wires as now proposed for the Delaware River bridge. It would be a great achievement most desirable also from the architectural point of view, to have big wire cables. In the writer's studies for the North River bridge they would have been 60 in. in diameter .. But it is one thing to design them and another thing to be assured of their safe obtainment.

That there are large secondary stresses in large stiff wire cables is now better understood than when the East River bridges were built, where they were not considered. The largest stresses from tension and bending occur at the towers, just in that part of the cable liable to have the most wire splices from adjustment of wires. Safe provision can of course be made for secondary stresses by increasing the cable section and leaving 150 to 200 ft. of cable at the towers uncompacted, so the wires can slide on each other for that length to prevent excessive stresses from the bending of the cables. All this can be done, but it adds to weight and cost of cables and is poor construction.

In chains of eyebars no uncertainties of stresses can occur, as all determination of length and all fitting are done in the shops with great accuracy, which must be one of the determining elements in any great metal bridge. This feature was well considered in the design made for the Pennsylvania Steel Co. for an eyebar suspension raidroad structure at Quebec in 1910. In Engineering News of Nov. 23, 1911, the comparison of weight is given with the official equivalent cantilever design. The competition in this case did not decide the merit of any competing designs, as the contract was awarded for a cantilever structure not complying with specifications and therefore 30 per cent lighter than any other design, including the so-called official design. The length of the river span (1,756 ft.) in this design was practically the same as in the proposed Delaware Bridge (1,750 ft.), so that the two are readily comparable when transposed to the different load conditions and the higher unit stresses would be justified with the present higher steels.

In this connection the report above mentioned on the chain design for the Manhattan Bridge, a carefully considered judgment from engineers of great experience and high attainments is worth thoughtful consideration. The cost of eyebar chains and wire cables is mentioned as being about the same (in 1903). The comparison was based on nickel-steel eyebars with 48,000 lb. elastic limit and 85,000 lb. ultimate strength. That was also the basis for the chain design for the Quebec bridge, 12 years ago. But since then progress has ben made in the metallurgy of steel, and large eyebars can be obtained of high steel with elastic limit and ultimate exceeding 80,000 and 110,000 lb. respectively. With such material an eyebar suspension bridge cannot help but be superior in quality to a wire cable design, and also cheaper in total cost, when properly designed. It is surprising that improvements in the art are ignored and that no studies for chain designs have been made by which the economy and merit of the proposed wire cable bridge could be tested. That could probably be best done by a competition of designs, but not of the kind had on the Quebec Bridge.

Studies for a large bridge cannot be considered complete until every phase of it has been examined in the light of progressive scientific knowledge. But in any or all designs for a large city bridge, architectural considerations should prevail, for the reasons already stated. That much its builders owe to the public and our age.

## REPAIRING ASPHALT STREETS IN WINTER

A method of repairing asphalt pavements during the winter months, when municipal and county asphalt plants usually are closed down, has been evolved with success by Charles L. Harrison, engineer in charge of street repairs at Cincinnati.

The old asphalt pavement is removed from the streets and hauled to the yards during the regular working season, the pavement being broken down to approximately two and one-half inches. The heating plant consists of four horizontal four-wheeled kettles, each of one hundred-gallon capacity. The old asphalt, broken to proper size, is placed in the kettles in the afternoon and the fire started at 5 o'clock the next morning. Four or five gallons of water are added and the covers are placed on the kettles. After being allowed to steam for half an hour the mixture is turned over with heavy bars, is spaded at one end and then allowed to steam again. The operation is repeated until at the end of three hours the water has evaporated and the mixture is ready for use at a temperature of 325 to 375 degrees Fahrenheit. It is then transferred to another kettle, under which a hot fire has been built, and is hauled therein to the street, where it is laid in the same manner as "new stuff," except that it is tamped into place instead of being rolled. The four kettles are never allowed to be more than half full, as the mixture cannot be done in an economical manner if the kettles are full.

The force engaged in breaking, heating and laying the asphalt in Cincinnati consists of only the seven men who are kept during the winter as the nucleus for the spring force and a driver for a two-horse wagon. No additional bitumen or dust filler is added to the old asphalt and the cost is slightly less than the average cost per square yard for repairs with new material.

## PORTABLE CONTROLLERS TO OPERATE CRANES

In the operation of large cranes used in building construction or for dock work it is generally necessary to have two men engaged, one working the controllers, and the other stationed at some convenient point to signal to the rest. With the aid of a device invented in Great Britain it is possible to dispense with one of these men. The device consists of a portable electric controller which can be slung over a man's shoulder and can be supported by means of a long, pointed leg. This controller is connected by means of a strong flexible cable with special gear operating the crane motors. The user has merely to press certain buttons on the controller to make the crane go through all its usual evolutions. Thus the operator can stand at any point convenient for observation or he can walk about from one point to another so as to secure a complete supervision of the working of the crane. This invention should be of the greatest assistance in saving labor in docks and on construction work generally.

Contractors! Don't fail to attend the construction conferenct, Hamilton. Ont., January 17th. to20th.!

# How May Construction Be Resumed?

## What is Necessary in Finance, Labor and Materials—Return of Confidence in Values in Building Will Remedy Present Slackness

Report of the Committee on Construction Industries of the U.S. President's Conference on Unemployment.

During the World War, private construction and construction of every nature not contributing to War purposes was prohibited. After the signing of the Armistice high costs prevented the resumption of genuine construction activities. The investing public in this field has not had confidence in the stability of values; they have not been able to determine if and when the cost of construction reached a point warranting their investment. A return of confidence in values in construction will assure more employment than in any other area.

There are three outstanding factors in the building and construction situation which have the greatest bearing on the resumption of construction activities. They are financing, material costs and labor costs.

These factors present questions which cannot be settled in a national way; they must be investigated by those interested in each community for itself. The questions are:

(a) Can the prospective investor finance the operation at a reasonable cost?

(b) Does the cost of construction materials to the prospective investor properly represent the reduction which has been made in the wholesale prices?

(c) Is labor in the particular locality working at fair rates and giving fair value in the quantity and quality of work done?

If local conditions prove satisfactory, there is no reason why work should not proceed immediately. This is especially true of persons contemplating the building of their own homes who are now paying rentals based on inflated values.

### Financing

Money must be made available on reasonable terms and in reasonable volume and free frrom demands or bonuses and commissions of a questionable character.

The savings deposits of the people are the natural economic source of loans for home building. The aggregate is ample for this purpose, even though a portion is protected by adequate investment in more liquid securities to meet withdrawals. There would be no difficulty in the financing of homes if the fundamental principle of the use of long-term deposits for home loan and long term purposes were generally followed.

In every section of the country owners have declined to start new projects on account of the financcing charges, both the interest rate and the commissions and premiums paid for floating loans being discouragingly high. Commissions and premiums varying between 10 and 20 per cent have been charged in addition to from 7 to 8 per cent interest. For example before the first work of construction was begun the owners of an apartment house were required to pay for the million and a quarter involved, an interest rate of 7 per cent and a bond premium of 1½ per cent, and a floating charge of 10 per cent, making a total financing charge of 18½ per cent. The financing charge of a subsequent loan of $250,000 for the same structure was $75,000. This is a charge of 30 per cent. It is doubtful whether the margins received by the architect, the contractor, and by all the producers in the basic industries involved aggregated a sum equivalent to these financing charges.

When an owner must pay such a sum before construction work even starts, many projects have necessarily been abandoned in the face of a continual need and demand for building.

While excessive financing charges for building have not been exceptional, many savings banks, trust companies, and insurance companies have maintained a conservative loaning policy with regard to real estate and home building and the building and loan associations have been conducted with exceptional efficiency. Underlying the whole matter of the financing of construction there is, however, the sound banking principle that long-term deposits and the savings accounts of the people should primarily be used for long-term purposes and should not be intermingled with speculative and commercial business.

### Material Costs

Many construction materials have been substantially reduced. Some may have been reduced to a point which is retarding production. It is apparent, however, that other construction materials have not yet been reduced in keeping with the trend of wholesale prices on other commodities. Manufacturers of such materials should be urged to promptly make their readjustments to a reasonable basis. They must realize that failure on their part to do so is not only limiting their own business but it is also interfering with the production and sale of other construction materials; it is interfering with greater employment; in a word, it is a contributing factor to holding back the progress of the entire industry.

In many instances retailers of construction materials have not yet followed the reduction of their manufacturers and wholesalers in their resale prices. This is an important subject to be taken up locally in each community. The retailers must be shown the necessity of bringing their prices to local buyers down to a point consistent with the reductions made in wholesale prices after taking into consideration increases in freight rates or legitimate increases in cost which exist in other directions.

### Labor Costs

This cannot be regulated by national action. The cost of living, rentals and working conditions differ in various communities.,Where fair wage adjustments have not been made, construction is held up. Such conditions should be dealt with fairly and frankly between employer and workmen and reasonable readjustments promptly made.

Approaching this subject, we believe that the employer should not permit the wage of his workmen to go below that point at which it not only provides sufficient to take care of the necessities of life but also enough to enable the family to educate the children properly, to provide reasonable comforts and conveniences and to permit systematic savings even though small. In the comparison of wages for building artisans with those of other industries, due allowance should be made for seasonal unemployment.

The workman, on the other hand, should deliver maximum production with proper interest in the welfare of the business out of which his wages are paid, and should eliminate restrictions and measures which tend to interfere with his production or with the production of others. Stoppage of work from jurisdictional controversies in the construction industry should be permanently abandoned as measures detrimental to the public welfare.

A factor contributing to the necessarily high costs in some localities, is the continuation of unfair practices.

### Unfair Practices

Notwithstanding the improvements which have taken place in some instances, with respect to the practices in the industry, it is apparent that there still exist trade abuses, waste, and unnecessary expense. It is a first essential of the proper development of the construction industry on a sound basis that all practices which unnecessarily retard the work or add to its cost should be immediately discountenanced and abandoned, if the confidence of the public is to be fully restored.

There are certain restrictions or limitations which were placed upon the industry during or since the war, which should be removed.

### Reduction of Freight Rates

This group recognizing that transportation problems are not within its peculiar province desires, nevertheless, to express the conviction that every reasonable step should be taken, necessary to enable the railroads to resume their customary activities, and to re-establish efficiency, economy and regularity in transportation service.

Readjustments of, and reductions in, freight rates on construction materials are essential to a sustained revival of building activity. Increases in rates on construction materials imposed during the war left the construction industry under a relatively heavier handicap of increased transportation costs than had been imposed on most other commodities.

To this war-time increase in freight rates has since been added an increase of 25 to 40 per cent, thus perpetuating and even magnifying the effect of the war-time policy of restricting general construction activity.

The construction industry cannot effectively function under a freight rate fabric artificially distorted by of failure to reduce and readjust freight rates, existing plants for the production of construction materials had to be abandoned and a new alignment of producing facilities established in accordance with the present rates, a fabric originally designed in the public interest, to discourage the very thing which, in the pubinterest, the government now desires to encourage: that is, the normal operation of industry. The financial burden of such a readjustment of plants would have to rest ultimately upon the public; and its necessary effect would be to curtail existing competition and to limit the radius of distribution of many of the construction materials.

In addition to such readjusment of freight rates on construction materials as will permit construction activity, freed from unnecessary artificial restriction, it is urged that such inequalities as may after such general readjusment exist in the rates on various construction materials be investigated and removed. We suggest the consideration of the practicability of encouraging during winter months the transportation of materials used in road and other construction work, thus utilizing transportation equipment which might perhaps otherwise remain idle.

### Building Codes

The development of the art of building through the adoption of new and economical scientific methods of construction is retarded throughout the country by the building codes of the various municipalities, which differ flagrantly as to floor loads, wall thicknesses and other elementary requirements which should be comparatively uniform, climatic conditions excepted. It is the opinion of competent authorities that as much as 20 per cent would be saved in certain cities by the adoption of building codes based upon modern scientific knowledge.

### Statistics

There is a definite need for statistics properly coordinated, accurately prepared, and furnished promptly—affecting production, capacity, and distribution of basic materials in the construction industry. The present confusion and limited information through handling by several departments is causing unnecessary expense to the Government without giving complete data and service to the public. Arrangements should be made as promptly as possible, so that statistics can be furnished by the proper department.

### Recommendations

It is recognized that the construction industry is a key industry, that there is a vast amount of construction needed, and that this construction work would afford employment to a large number of men directly and indirectly, and would result in the creation of permanent and useful wealth, translating wasting labor into earning capital.

To meet the present unemployment emergency and to make renewed activities in the construction field possible does not require special concessions to the industry. But it does require a complete and prompt removal of unnecessary handicaps, restrictions and limitations, both direct and indirect, these including credit, freight rates, priorities, undue costs in relation to labor and materials, wasteful building codes and the like.

## TOWN OF MOUNT ROYAL IS EXTENDING

A new section of the town of Mount Royal, P.Q., is now being opened up and developed under the direction of the Canadian Northern Land Company, namely, that part which lies between Rockland and Allen avenues, the latter avenue forming the boundary line between the Model City and Park avenue extension.

Sewers and water services have been laid in practically the whole of this section, preparatory to its being built up and developed, and practically all public services have been provided for during the past summer, except that of transportation, in regard to which a certain amount of improvement might still be desired.

For the purpose of opening up this district, a new subsidiary company has been formed by the Canadian Northern, under the name of the Rockland Housing

Company. This subsidiary has been incorporated under Quebec 4, George V., Chap. 47 and Quebec 9, George V., Chap. 10, to take advantage of the facilities offered by the federal government for borrowing money with which to build dwelling houses, passing on to the ultimate purchaser the facilities of payment offered by the government in respect of the borrowed money. One of the provisions of the law governing companies building houses with money thus borrowed from the government, is that the amount of profit they may show on their dealings is limited to 6 per cent.

The houses are to be of six and seven rooms, and will cost probably around $6,250 for the six-roomed, and $7,000 for the seven-roomed houses. That proportion of this cost which is borrowed from the government will be subject to 5 per cent. interest, and repayable over a period of twenty years. The balance will be carried as a second mortgage and payable in ten years, subject to 7 per cent. interest.

## STANDARD LENGTHS, SIZES AND QUALITY OF LUMBER AS RELATED TO ECONOMIC DESIGN

Since labor has become a most significant factor in the cost of building, and since there are certain established standards of lengths and sizes, as well as significant differences in grades of lumber, it is important that the use of these standard lengths, sizes and grades be intelligently applied to the design of buildings for the purpose of reducing the cost of construction where possible.

In designing the floor plan of a building, the fact that standard lengths of joists are multiples of two feet, 4 ft. to 24 ft. inclusive, should be an important consideration in determining the widths and lengths of each room.

Odd lengths, such as joists 9, 11, 13 and 15 feet, not commonly carried in stock, are charged as the next longer even length and cut at the lumber yard before delivery, or delivered in the next longer even length, necessitating cutting by the carpenter on the job. The waste here is obvious, both in material and in labor, and could easily be avoided by careful design.

A building does not necessarily have to be an even number of feet in width in its over all dimension. Take, for example, a brick building, which is built 24 feet wide with 12 inch walls. Joists which are 24 feet long can be used, but at least 16 inches must be cut from the ends to have the proper extension of the joist ends in the brick wall, whereas, if the building had been built 25 feet 4 inches wide, 24-foot joist could have been used with no waste, or by decreasing the width but 8 inches, 22 foot joists could have been used.

When designing heights of stories, whether in Braced or Balloon Frame, Ordinary or other types of construction in which wooden studs are used, standard lengths are quite as important a consideration as joists, and economy may be practiced with the same result. To be sure, 9 foot and 11 foot lengths may be cut from 18 foot and 22 foot lengths, respectively, but why necessitate even this amount of additional labor when avoidable?

Whether the schedule of lumber ordered be large or small, if the material listed be of standard instead of odd lengths, a material saving, as well as more prompt delivery is assured.

It should also be remembered that whenever the size of lumber is given in whole numbers, such as, 2 x 4, 2 x 6, 2 x 8, etc., standard commercial or nominal sizes are meant; but whenever the size is given as $1\frac{5}{8}$ x $3\frac{5}{8}$, $1\frac{5}{8}$ x $5\frac{5}{8}$, $1\frac{5}{8}$ x $7\frac{1}{2}$, etc., actual sizes are meant, and stresses should always be based on actual size of material used.

In the selection of materials, particularly of timbers and wooden beams to be used in building, care should be exercised to select good, sound materials, free from rot, large or loose knots, shakes or any imperfections whereby the strength may be impaired, and of such size and dimensions as are required for the kind of building erected.

Upon ascertaining from your lumber dealer the prices per 1,000 feet of several sizes and lengths of lumber, it is a simple problem in mathematics to determine whether it will be more economical to use sixteen lengths of 2″ x 8″ joists, 16″ on centres in the floor construction under a certain room, or to use twelve lengths of 2″ x 10″ joists, 20″ on centres for the same purpose, and similarly, of two lengths of 2″ x 4″ studs 8′ long, can be used more economically than one length 16′ long and answer the same purpose. Care should also be exercised in the design of roofs, so that the pitch of the roof and the projection of the cornice or eaves is so arranged as to use even lengths of materials for rafters.

As the flooring for porches is generally laid at right angles to the house proper, the width of the porch should be such that material here will cut also to the best advantage.

If these few points are adopted by architects, engineers and contractors, to make more efficient the design and application of lumber in building, much waste can be avoided and a considerable reduction in cost of construction will result.

## NEW FLAME CUTTER

For many years the oxy-acetylene flame has been largely used for cutting plates, girders, and other pieces of iron or steel. For rough work the ordinary acetylene blow-pipe is quite satisfactory, but where it is desired to cut out a piece of metal with a sharp edge the blow-pipe by itself is not suitable, as it leaves a ragged edge, where it cuts. The wide scope for an oxy-acetylene cutter which would give a fine edge has induced a British inventor to undertake very close research into the best form of blow-pipe. After spending many thousands of pounds and undertaking many experiments he has succeeded in devising a blow-pipe which cuts almost as fine an edge as a saw. He has developed, in conjunction with this blow pipe, an ingenious machine which enables any shape to be reproduced; that is to say, once a pattern has been made the machine will reproduce it as often as required by cutting metal sheets to precisely the same shape. The process is so rapid and so perfectly performed that the machine has attracted the greatest interest among railway companies, motor car manufacturers, and others who have a large amount of reproduction work in sheet metal to perform.

## BUILDING ACTIVITY IN NORTH SYDNEY, N.S.

A very considerable activity during the past summer is reported from North Sydney, N.S. Mr. Jos. Rowsell has remodelled a residence for Capt. Jno. Cains, built a new residence for R. P. Scott, and has practically completed houses for Joseph Moore and Mrs. J. D. McDonald; at the present time he is just beginning a $5,000 home for R. T. Smith. F. C. Redding is building a concrete block house on Commercial Street.

# Lining Railway Tunnels Under Traffic

## Various Schemes Used by Several Railway Companies are Described—Pneumatic Concreting Generally Adopted Although Hand Methods are Used for Short Tunnels

From a committee report presented at the annual convention of the American Railway Bridge and Building Association.

The kind of lining selected upon differs somewhat on the various railroads. Some roads deem it advisable to line with concrete only, others use concrete back walls and brick facing. The concrete lining has proven the most economical to install, especially with present-day methods—the pneumatic process being the latest development in this line. By this process the work may be carried on successfully with little interruption to traffic and to the work. There are various designs of machines for this work and the methods are divided as to application of the lining. There is now a machine by which a grout of sand and cement is applied to the rock walls of the tunnel, either with or without reinforcement, as the conditions warrant. Thus the grout is sprayed on the walls in successive layers until the desired thickness is attained. The aggregate is placed in a conical-shaped hopper where it is mixed and thinned to the proper degree by the injection of water into the discharge pipe after the dry aggregate has left the machine. This has proved to be a satisfactory method of lining rock-faced tunnels where there is considerable seepage or where decomposition is setting in.

### Lining Tunnels by Hand Methods

Lining tunnels by the so-called hand method has been accomplished under traffic very economically when the circumstances were favorable. This is done in long tunnels by the use of the jumbo car with the staging high enough to permit of the concrete being shoveled into the form from this elevated platform. In some cases the side walls are poured ahead a considerable distance and the arch brought up later; in other cases the entire form is filled at one pouring, making a complete monolithic section. The difficulties encountered in this method are generally caused by the interference with work by traffic, making the work spasmodic and creating an economical loss which can be overcome only by the strictest supervision and the employment of a small crew of men.

Where short tunnels are to be lined the hand method is probably the most practical. The staging can be erected high enough to give safe clearance for trains and also to give room enough to work. A continuous staging is thus carried along from the mouth of the tunnel and the concrete is conveyed from the outside of the staging.

On the Southern Pacific R. R. in some instances, a 4x5-ft. drift has been opened up over the top of the tunnel timbers, where the earth formation was favorable, a track laid on the tunnels timbers and the concrete carried into the forms in dump cars. In this case the form can be poured to the top with little shoveling.

Wooden forms constructed of 3x8-in. studs, spaced 2 ft. on centres with 1x6-in. sheathing, and in 12-ft. sections are used. The form arch is hinged to the wall of the form with plates and bolts, so that to move the form ahead it is only necessary to draw the side walls in and lower the arch enough to clear. Then the entire form is pulled ahead as far as necessary on pipe rollers and reset for filling. Walling pieces of 4x6-in. pine at the middle and top of the side walls are tied back by wire or bolts to the tunnel timbers, and the foot of the form is braced to the track ties. The open end of the form is closed up with 1-in. material and braced.

A spur track of four or five cars' capacity is put in as near the tunnel as possible and sand and gravel unloaded on a plank floor. The cement house of two cars' capacity is located as conveniently as possible to the mixer and also on the spur track, so that the cement is handled as little as possible. The aggregate is hauled in wheelbarrows to the ½-yd. mixer, and after being mixed is elevated by a tower to the dump cars which are at the elevation of the tunnel staging or to the drift over the tunnel as the case may be. The cars are then run into the tunnel by gravity and are pulled back by a light cable from a donkey engine, which also does the hoisting.

This work is carried on with 20 men, and averages about 36 ft. of tunnel lined per week with a single shift. Although the pneumatic machine was working on other tunnels in the vicinity it was not considered practical to use it on these short tunnels 200 ft. in length, as they were somewhat isolated and water service was poor at these points.

Several short pieces of lining were done by this method, the drift over the top being used only where it could be easily opened, but the work was found to cost more than with the pneumatic method.

### Lining Tunnels by Pneumatic Method

The Southern Pacific R. R. has now practically adopted the pneumatic method for the lining of its tunnels under traffic. The first piece of work of this nature consisted of enlarging to standard size and lining with concrete the tunnels on the Tehachapi Pass and the San Fernando tunnel, all of which are located on the single track main line between San Francisco and Los Angeles. Of the 18 tunnels on the Tehachapi section 11 were lined throughout by the pneumatic process, 2 were eliminated by a line change, 4 were lined by the hand method, being short jobs, and one was simply enlarged and not lined, being of solid rock section throughout. The line through the Tehachapi Pass follows the Tehachapi creek at various elevations along the steep slope to the creek, and all the tunnels are on 8 to 10° curves. The formation of the earth consists of broken rock, loose sand and decomposed granite, so that in all cases the timbering was close.

It was decided to enlarge and line the tunnels to a standard size with a minimum overhead clearance of 22 ft. and a minimum width of 16 ft. on tangent track and 17 ft. on curves of over 2°. The cross-section of the bore consists of vertical walls 14 ft. 6 in. to the spring line, and an arch of 8 ft. radius and 8 ft. 6 in. radius, respectively, for the 16-ft. and 17-ft. horizontal widths.

The difficulties encountered were numerous. The immense business carried by the Southern Pacific R. R.

and the Santa Fe Ry., which run jointly over this track, was the greatest problem to cope with, for not only were there 14 passenger trains and 8 scheduled freight trains daily, but in the busiest seasons as many as 67 trains were passed over this line in 24 hours. All ascending trains, of course, leave their trail of smoke and gas, which on calm days lies in the tunnels for long periods. On account of the heavy grades great care had to be exercised in flagging trains to protect the workmen, and a watchman was stationed near the tunnel to warn all men of the approach of trains. With these precautions the entire work was prosecuted with no injuries.

Small electric units were installed to furnish light, which proved to be a great saving over the old torch method of lighting. In preparation of these tunnels for lining, the old timbering was removed and new 10x14-in. timbers installed on concrete footings, which furnished the basis for the future lining. The arches were of the three-segment octagon type, and gave a clearance of 23 ft. overhead and 19 ft. 6 in. horizontal for 17-ft. tunnels. All of the concrete-lined tunnels were timbered throughout and the timbers left in place with exception of spreaders or girts and all unnecessary woodwork, which were removed from between the timbers. Where it was necessary to install inverts, on account of swelling ground, this was done after the lining was finished. Most of the tunnels were solidly lagged behind the posts and all cracks and holes were battered and plugged prior to setting the forms for concrete.

### Getting the Aggregate to the Mixer

In laying out the plant on the outside it was found that a 5-car spur was the greatest length that could be secured and in some instances only a 2-car spur was possible. The spur was placed as near the tunnel as possible. Where a drag line was used to deliver the gravel to the mixer the spur was elevated 4 ft. to give room to handle bottom-dump cars, but where a clam shell was used it was not necessary to elevate the track as the cars could be unloaded by the clam shell.

Three different methods were employed to convey the gravel and sand separately to a dipper, which was hoisted by a small air motor. This required a fleet of eight wheelbarrows and six shovelers, to keep gravel at the mixer, and considerable lost time was experienced by this method. Besides these men it required eight more men to unload gravel from the cars.

To overcome this expensive feature a 25-yd. hopper was built over the mixer and a bucket elevator was installed at an expense of $700. The elevator was operated by air; it required only seven men to keep the hopper full, and there was no delay in getting gravel to the mixer. The spur track was also elevated and five men kept the cars empty. The gravel and sand were now delivered ready mixed in proper proportions. This elevator paid for itself quickly and this method was later improved upon by pulling the gravel up to the elevator with a drag line from a donkey engine. Three men now furnished gravel to the mixer and five men from the bull gang kept the cars empty.

Later on when a locomotive crane was available it was used to handle the gravel and proved to be the most economical of all, as with this crane the cars could be emptied and gravel supplied to the mixer with the use of only three men. Besides this the crane was a great labor saver in setting up the plant, loading and unloading material and made itself useful and economical in many ways about the work.

The cement house was placed adjacent to the mixer and also close to the spur track, so that cement could be handled easily, both from the car and to the mixer. A 3-car capacity cement house proved ample for the work.

### The Mixing Plant

The machine used for placing the concrete lining consists of a cone-shaped hopper with a trap door at the top and a cast iron elbow at the bottom or apex of the cone. The hopper is built of ¾-in. steel plates and is made in ¼-yd. and ½-yd. sizes. A 6-in. discharge pipe is used for the ¼-yd. batch. In the Southern Pacific work the ¼-yd. type was used and was located as near the gravel storage as possible to facilitate the handling of the gravel. Over the mixer a 25-yd. hopper 10 ft. square was built in sections so that it could be taken down and moved easily. The gravel is drawn from this hopper through an air-operated gate at its lower point into a ¼-yd. measuring hopper and thence into the mixer. This is done quickly and it requires but a few seconds to load the mixer with the charge.

The compressor was of the Ingersoll Rand Imperial Type 10, having a capacity of 925 cu. ft. per minute. It was belt driven by a 320 h.p. gas engine. Both engine and compressor were installed in a steel frame box in order to make them portable as the conditions demanded. The car, when located in a suitable place, was lifted from its trucks and rested on wooden frame bents on concrete. The car was braced at each end with I-beams to the rails, which, with 18-in. screw jacks, took up the thrust of the car when the engine was working.

Two 3-in. pipe lines carried the air from the compressor to the mixer, and the air storage consisted of small tanks with a total of 400 cu. ft. capacity. This capacity was ample for a shot of 1,200 ft. and was reduced to 140 cu. ft. for the shortest shot of 250 ft.

As this entire plant was to be used at all tunnels over 200 ft. in length it had to be made portable, and it generally required seven 8-hour days to set it up, and the same length of time to prepare 1,000 ft. of tunnel and set up the steel forms ready to fill, with a force of 40 men.

Five steel ribbed forms of the Blaw collapsible type were used, each form being 20-ft. long, and covered with 3-in. pine lagging. All forms were set up outside the tunnel and rolled in on their own wheels, on a light rail spaced 25 in. from the face of the concrete on either side, 3 in. below the top of the main line rail. The forms were spaced in the tunnel so that they would operate toward each other, the intention being that all forms should cover the discharge pipe.

### Placing the Concrete

From the mixer a 6-in. standard steel pipe was laid into the tunnel. The pipe was connected with 6-hole cast iron flanges, and extra heavy pipe was used for bends. The pipe was laid on the ground to a point midway between two forms where it arose to the top centre of the tunnel through the extra heavy bends. It was then carried on hangers in the top of the tunnel. By reversing one elbow two forms could be shot with one set-up of the pipe. The same precedure was followed with the other two forms, but the fifth form required a separate set-up of pipe. As the two forms were filled the ground connections of the pipe were changed and the next two filled. This could be done in

30 minutes, at least, and when no delays occurred shooting could be resumed in the next form in that length of time. The pipe was anchored to the timbers with chains and turnbuckles, as the thrust was very severe at times, and it would break at the flanges quickly unless so anchored.

On the end of the pipe at the form a 6-ft. nozzle, consisting of extra heavy 6-in. pipe, with a slight curve in it, was flanged on. This deflected the concrete to the side walls until the concrete arose to the crown of the arch on each side. It was then removed and a straight pipe put on to finish the key of the arch.

One-half inch steel plates were used as baffle plates on the timbers to keep them from being cut through by the concrete, and were removed when the concrete reached that height. It was also necessary to put steel sheets 4x10 ft. by 1/16 in. thick on the forms where the concrete struck, otherwise the lagging soon became rough and caused trouble. Care was taken to keep the forms well cleaned and oiled to prevent sticking. The forms were cleaned by air.

A 1-in. line laid through the tunnel from the air reservoir furnished air for this purpose, and, with a hose and short pipe nozzle, the loft man could keep the form clean by blowing all loose rock and cement off when necessary.

The discharge pipe gave considerable trouble in the early stages of the game through wearing out at the bends, but this was overcome by case-hardening and putting on heavy patches with clamps. In this manner 1,000 to 1,500 yd. could be shot through a bend before it became useless.

The forms when placed were raised and spread by screws attached to them, but it was necessary to block the form ribs up well and tie the forms back to the tunnel timbers with ¾-in. bolts at the centre and at the spring line. The foot of the form was braced to the track ties and it was found that considerable bracing and tying was necessary to hold the form in place successfully on account of the rapidly increasing weight as the form was filled, for the concrete was practically alive until the entire side was filled. Many times it was found necessary to allow some time for setting by changing the pipe from one side of the form to the other side, where the tunnel was only partially lagged up back of the timbers or where large cavities occurred.

An electric bell with a code of signals was used to advise the mixer operator when to start shooting and when to stop, and to give him other necessary information as to the progress of filling the form. The concrete placed by this method was found to be well mixed and of good quality when crushed rock of 1 in. to 1½ in. size was used with good, clean sand, but round rock and pebbles did not do as well, as they had a tendency to roll into pockets, which sometimes caused considerable trouble.

### Sticking Caused Trouble

It was found necessary to have a man patrol the line with a hammer as the concrete frequently stuck in the pipe and had to be hammered loose. In the long tunnels two or more men were necessary in order to prevent delays on this account. In an effort to overcome this sticking or plugging and to give more plasticity to the concrete, hydrated lime was added to the batch. One-quarter of a cubic foot was added to each ¼-yd batch, but no improvement was noted, and the only remedy seemed to be to add more water. Under these conditions the sticking was very much minimized but it became much harder to hold this excess fluid in the form, although the quality of the concrete appeared to be as good or better than with the dryer mix.

The concrete was reinforced with ¾-in. twisted or deformed steel bars spaced 12 in. on centres for the vertical steel and the arch, and 24 in. on centres for the horizontal steel. Twisted steel plugs were left protruding 9 in. out of the concrete footings, when built, to tie to, and all the steel was securely tied with No. 14 annealed wire.

The aggregate was furnished in 1:2:4 proportions and was put into the mixer dry, and 10 to 12 gal. of water added. Everything was arranged so that rock, sand, cement and water could all go into the mixer at once. When shooting from 150 ft. to 200 ft. as high as 96 batches per hour were handled for distances of 700 ft. to 800 ft., 60 batches per hour, and at 1,200 ft., 45 batches.

To operate the plant successfully sufficient water should be on hand. In these tunnels water was taken from a 6-in. gravity line by installing a valve. This, with the addition of a 2,000-gal. tank, elevated 60 ft. above the plant, gave sufficient pressure for the engine and mixer, as well as for camp and other purposes.

To shoot the concrete successfully it was found necessary to maintain an air pressure of from 75 lbs. to 90 lbs. in the receivers. When shooting at 80-lb. pressure a drop of 20 lbs. occurred before the batch was entirely discharged. This varied with the distance from the mixer to the form, but the maximum variation with the 400 cu. ft. receivers was 30 lb. when shooting a distance of 1,200 ft.

As the lining progressed and the two forms approached each other from 10 ft. to 14 ft. was allowed as a finish form. This form was finally filled through a 2x4-ft. recess left in the top and end of the last section of concrete. Through this hole the pipe was inserted and the hole was big enough for the loft man to crawl through to clean the form. When the form was filled the pipe was pulled out and this recess reinforced and filled, completing the work.

The forms were then rolled out and in one case were hauled intact to another tunnel a mile distant by work train with no delay to trains and all in five hours. Otherwise the forms had to be dismantled and knocked down to move to the next job.

### Continuous Pouring Produced Best Results

As in all concrete work, continuous pouring of a unit produces the best results, so in tunnel lining a section should be completed in the shortest time possible to avoid seams and offsets in the concrete. It was therefore found most practical to work two 8-hour shifts, one shift starting at 6 a.m. and working until 3 p.m., and the other shift continuing on from 3 p.m. to 12 o'clock midnight, taking the usual hour for lunch. In this way a section of 20 ft. could be completed each day.

After completing the section and making another form ready the night shift changed the pipe and did what other work was necessary for the day shift to start promptly after 6 a.m. on the work of placing concrete. Six 20-ft. sections were completed each week with the double shift, and in some cases of short shooting seven could easily have been blown, but the lack of forms and the four days required for setting of the concrete, made it impossible to complete seven sections in six days.

The forms varied somewhat in the amount of concrete necessary to fill them. This variation was due to the nature of the lagging in the tunnel. Some portions of the tunnels had no lagging where good rock was encountered and in these instances the concrete filled all cavities and voids in the rocks and, of course, required more filling as it was not considered practical to fill these voids other than with the concrete. Some 20 ft. sections of this nature required from 90 yd. to 105 yd., but the ordinary section, where timbers were well lagged, required an average of 80 yd. or 3.5 yd. per tunnel foot.

### Labor Organizations and Cost

A crew of 40 men was used on the day shift, consisting of a foreman and two assistants, 16 carpenters, an electrician, an engineer and helper, a pipe man and helper, a craneman, timekeeper, 3 flagmen and 12 laborers. The night shift was composed of 20 to 25 men, consisting of the foreman, an assistant, 8 carpenters, an electrician, an engineer and helper, a craneman and 6 or 8 laborers. As the day crew did bulk of the work, the night crew was not necessarily as large, as it was considered practical to start blowing a new form and let it set unfinished for six hours.

The cost of these tunnels varied somewhat owing to conditions on the ground, the fluctuation in wages and the uncertainty of delivery of material, during the 57 months that the work was in progress. Costly delays were experienced through labor shortage and lack of material delivery. During the time that this work was in progress the weather conditions were favorable, there being little snow and frost to contend with as on other jobs in colder climates.

The cost data on a typical tunnel 684 ft. long lined by the pneumatic method is reflected by the following figures. This is tunnel No. 3 of the series on the Tehachapi Pass. In this case there was a spur track of 4-car capacity. Material was supplied to the job by local train service and very irregular. Considerable delay was caused through lack of material delivery from a commercial plant located 200 miles from the tunnel. The work was done during a period of extremely high wages, carpenters and mechanics receiving as high as 83 ct. and laborers 51 ct. per hour. One shift of 8 hours only was used and the gang consisted of about 35 men. Gravel was delivered to the mixer by a drag line and elevator, which was somewhat costlier than handling by the crane as was done on later jobs. The entire cost of concreting this tunnel was $31 per lineal foot for labor and $33 per lineal foot for material.

Knowing little about the handling of the plant, it took some time to perfect an organization whereby an economical showing could be made, but considering circumstances and the difficulties under which the work was done, it was considered that a very satisfactory showing was made.

The work was carried on by company forces. Geo. Rear, bridge engineer for the Southern Pacific Co., engineered the work of putting the machinery in motion and lining the tunnels. A. Fraser, supervisor of bridges and buildings at Bakersfield, supervised it, and the chairman executed the job of lining.

### Method of Lining San Fernando Tunnel

The lining of the San Fernando tunnel is being prosecuted in a somewhat different manner with respect to the form work and the execution of the work in general. The lining is carried on in conjunction with the enlargement of the bore, and as the traffic is approximately 50 per cent. lighter at this point and other rail connections give an outlet for traffic in case of trouble, the work has not been followed so intensively as in the tunnels on the Tehachapi Pass. This tunnel is 6,696 ft. in length and is cut through a rugged range of hills composed of sandstone, conglomerate, shale and solidified ocean mud. The lining was started in July, 1919, and to date some 2,300 ft. has been completed.

The cross-section of the bore is vertical walls with an arch of 8-ft. radius, the finished width being 16 ft. and the overhead clearance 22 ft.

The reinforcement of the concrete is the Southern Pacific standard, as in other tunnels, and the volume of concrete per tunnel foot the same. The pneumatic method is used here much in the same manner as in the lining of the Tehachapi tunnels, with the exception that it is not necessary to have such large storage capacity for the aggregate and the rock and sand are handled by wheelbarrows.

Two compressors furnish air for the blowing at this tunnel and are electrically driven. As the power lines of the Southern California Edison Co. are in close proximity to the work it was deemed advisable to obtain this power. One Ingersoll-Rand compressor has a capacity of 1,150 cu. ft. per minute, and the other, a Chicago pneumatic compressor, has a similar capacity.

Two compressors are used here instead of one on account of the long shooting, the distance of the shortest shot being 2,300 ft. It is figured that as the air is exhausted from one compressor the volume of air in storage from the other compressor can be quickly turned into the line, following up the batch and driving it on to the form.

The mixer used is a Houghton of ¼-yd. batch capacity and a 6-in. standard pipe line is used as a discharge pipe, flanged at the joints with standard cast iron 6-hole pipe flanges.

Wooden forms are used here, which are constructed of 2x6-in. pine doubled for studs and placed 2 ft. on centres with 1x6 in. SIS pine for horizontal sheathing. The forms are held firmly in place by ⅝-in. bolts with heads spiked to the tunnel posts, one on each side of the post, the threaded ends projecting through the form and through waling strips of 2x6-in. pine doubled, 4-ft. on centres.

The arch ribs are made of six-segment two-ply 2x12-in. rough pine bolted together with 4x6-in. tie beams 18 ft. above the top of rail, as a spreader. This gives a stable arch and one which can be handled conveniently. The arch rib ends drop to a point about 12 in. above the spring line to a 2x6-in. plate. Between this plate and a similar plate on the top of the side walls, short 2x6 in. studs are inserted which are knocked down when the arch is ready to be dropped. This gives ample clearance for the arch in moving it ahead to the next section. The walls and arches are in 12-ft. sections and, in placing the concrete, the entire form is filled before moving ahead, making a complete section. The concrete footings were installed along with the retimbering and enlarging of the bore, this work being done by hand only.

The 6-in. discharge pipe from the mixer rises from the ground when within 300 ft. of the form to be blown. The only bends used consist of short 45° cast iron elbows of approximately 3-ft. radius. By the use of these cast elbows the pipe is carried to the centre of the top of the tunnel where it is supported by round iron hangers to the top segment of the tunnel arch. No special nozzle is used on this pipe, the concrete being discharged into the form directly from the straight pipe.

### Pouring the Alternate Sections

When it is necessary to pour a section between two sections previously completed the pipe is brought up to a height beneath the form that will clear trains and then turned vertically through the centre of the form an equal distance from the ends of the form. A recess is excavated in the roof of the tunnel, planked up and baffle plates put in. This recess is large enough that the concrete, when striking the roof, will spread itself equally in all directions. The pipe is projected about 5 ft. above the inside of the form so that the concrete cannot run back down and so that the form will be well filled. The pipe is then disconnected and plugged with sacks and pulled down out of the form. In this manner the lining progresses at the rate of from 12 ft. to 18 ft. per day of eight hours when shooting, but no attempt is being made to shoot every day. A section is placed three times a week, the other three days being used to erect reinforcing steel and the forms. The length of the form is regulated to suit the distance of shooting and the rapidity of discharge, which is governed by the distance from the mixer to the point of discharge, or the form, and varies from 12 ft. at a distance of 2,000 ft., to 18 ft. at a distance of 800 ft. to 1,000 ft. By so regulating the work it is possible to complete a section within the eight hours.

The personnel of the force engaged in enlarging and lining consists of a general foreman, two assistant foremen engaged in enlarging and retimbering ahead of the concreting, and 40 other miscellaneous men such as carpenters, laborers, flagmen and watchmen, there being a total of 45 men in all.

This work has thus been carried on very methodically and economically. The object in this tunnel is to carry on the lining in conjunction with the enlarging and retimbering of the section and by so doing a material saving is effected, in that it is possible to eliminate some of the otherwise necessarily heavy timbering. By prosecuting the work in this manner at this tunnel it has been possible to place 750 ft. of this concrete lining, together with the footings, at a cost of $24 per lineal foot for labor, and a total of $53.06 per lineal foot for labor and material, exclusive of superintendence, tool rental, store expense and other incidentals.

### Lining Tunnels on the Lehigh Valley R. R.

Two novel methods were used by the Lehigh Valley R.R. in relining short sections of two of the tunnels. One, a double track tunnel, was partly lined with brick when constructed, but as time went on the brick disintegrated and bulged to such an extent as to become dangerous and clearances were reduced. In 1890 a shaft was dug from the top of the ground above the tunnel down to the top of the brick arch and a second arch and side walls were built around the whole of the original tunnel, and then the brick arch was removed and the inner surface of the new concrete arch faced to produce clear and neat surface lines. During the progress of the work, a single track was operated through the centre and before the work of excavation for the inner arch was started the part of the tunnel under repairs was completely supported by temporary bents, the centering thoroughly wedged to the old arch for its support, and the pressure produced by the soil from the rear or top.

The other tunnel was completely arched with brick when constructed, about 1886. A few years ago about 115 lin. ft. of the arch showed some signs of sagging and bulging. This tunnel is also double track and all the clearances available were required for the traffic, especially near the eaves of the equipment. Directly above the centres of the tracks and between the tracks, some space could be spared. At this tunnel the side wals are of stone to the springing line. This brick was built of separate arches 21 in. thick.

The defective section of the tunnel was lined with cast iron segment arch sections bolted together at the ends and along the sides through the flanges. At the springing line, and for a short distance upward, part of the brick arch was cut away to make room for the cast iron lining.

This lining was shaped so as to form a complete but flatter arch under the brick arch, and the space between the cast iron arch and the brick was grouted with a cement gun; this was done for each complete ring separately as it was completed. After all the cast iron lining was in position, steel-crete metal was wrapped about the flanges of the cast ribs and the whole inside surface (including the bolts), covered with a thin layer of gunite, placed with a cement gun, to prevent destruction of the metal by the gases from passing locomotives.

To do this work single track was operated through the tunnel and the defective section completely centred to support the brick arch; this centring was replaced as fast as the cast iron section was replaced. This was a very interesting piece of work and required a good deal of study, but was completed successfully.

### Lining Connaught Tunnel of Canadian Pacific Ry.

The 5-mile double-track Connaught tunnel of the Canadian Pacific Ry. under the Selkirk mountains near Rogers Pass has just recently been lined with concrete. The construction plant and equipment presented some exceptional problems. To them may be added an altitude of 4,000 ft. above sea level, an average snowfall during the winter of 40 ft. and a distance of 220 and 420 miles to the nearest cities where materials, equipment, and labor could be obtained.

The principal requirements for the plant were the storage and handling of material outside the tunnel, the transportation of men and material into and out of the tunnel, lighting and the mixing and placing of the concrete.

The plant itself had to be laid out with sepcial consideration to safety, non-interference with railway operation, non-interference with signal and other circuits, fire hazard, reasonable and economic speed in performance and special weather conditions in the mountains. Practically every variety of layout was considered to meet the above conditions.

It was decided to construct a central electric generating station which supplied power sufficient for brilliant lighting of the working zones within the tunnel and for the operation of a plant mounted on cars, conconsisting of air compressor with its operating motor and auxiliary apparatus, storage space for the materials for the aggregate, and motor operated mechanical premixing and air-placing concrete apparatus. A transmission line to the working zones, transformers, low tension lines to lights and motors, and a gasoline locomotive for hauling this plant and the supply cars were the necessary adjuncts of the plan.

The heart of this scheme was the electric power plant which was located near the west portal of the tunnel at Glacier station. On account of the topography it was not feasible to place the power plant at the main line level, and it was therefore located on an embankment south of the railroad. Three old locomotive boilers were used for the power plant.

Immediately after the passage of trains, particularly when operating against the 1 per cent. grade in the tunnel, smoke conditions made work extremely difficult. Most careful consideration was given to a variety of schemes for illuminating the working sections under smoke conditions and at the same time for not over-illuminating the work after the smoke had cleared. Numerous laboratory experiments were made. Flood lights of 500-watt capacity each were finally decided upon. These lights were portable and adjustable as to diffusion of beam, and worked out in practice exceedingly well, permitting illumination to be varied immediately to meet any particular set of conditions obtaining in the tunnel at any time. They also cut the time lost due to smoke and showed a large saving in labor costs.

Two 75-ton pit flat cars were coupled together to carry the concrete mixing and placing apparatus. On one car was located a 1,200-ft. motor-driven compressor, while on the other car was located a mechanical concrete mixer of 22 cu. yd. per hour capacity and a pneumatic placing apparatus of the same capacity. Storage bins for sand and gravel were provided on each car with a belt conveyor to carry material from one car to the other. Cement storage and water tanks were located convenient to the mixer. Storage was calculated on a basis of blowing a complete form without leaving the tunnel to recharge. Sand and gravel were delivered to the mixer skip by gravity and the mixed concrete dropped by gravity into the air placer. Necessary pipe and flexible hose connections to the forms were used.

In operation the cars were spotted near the forms to be blown and jacked up in order to take the weight off the springs. Electric power connection was made to the nearest outlet on the power distribution line. No difficulty was experienced from vibration or rocking, although the compressor motor had a capacity of 200 h.p. at 500 r.p.m.

A 27-ton gasoline locomotive was used for hauling the mixer cars in and out of the tunnel, the handling of the rock scaling and derrick cars, materials cars, switching of cars in the yard, etc. It was also used in running lunch cars into the tunnel in order to save working time otherwise consumed by the men going out for lunch, and in general the many miscellaneous switching uses continually arising on work of this kind. The engine was rated to handle 210 tons on a 1 per cent. grade and was operated by one man. An electric locomotive would have imposed excessive costs and a steam locomotive would have aggravated smoke conditions. The effect of the exhaust gases from the gasoline locomotive was carefully considered but found to be negligible.

Six Blaw-Knox collapsible steel forms were used, each providing 20 ft. of finished tunnel lining at one placement. These were made to clear all traffic. Each form was on wheels and after the concrete was set the top plates were collapsed and the forms rolled forward to their new position.

The proper and comfortable accommodation for 200 men in the heart of the mountains was an important and difficult question. A complete camp complying with government regulations was gradually built up, consisting of sleeping quarters, subdivided into units of four men each, bathhouse and laundry, separate small houses for married men, community dining room, kitchen, storehouse, roothouse, etc., comprising a total of about 60 buildings. All quarters were electric lighted and provided with water. Heat was furnished by stoves. A drainage system and septic tanks were installed.

## CLAY PRODUCTS ASSOCIATION WILL CONVENE IN TORONTO ON FEBRUARY 7-9, 1922

The annual convention of the Canadian National Clay Products Association will be held at the Prince George Hotel, Toronto, on February 7, 8 and 9, 1922. Arrangements have been made for the following papers: Field Tile in Canadian Agriculture, by F. L. Ferguson of the Ontario Agricultural College, Guelph; Making and Marketing Drain Tile, by H. H. Hallatt of the Tilbury Brick & Tile Co., Tilbury; National Importance of the Clay Products Industries, by A. G. Dalzell, consulting engineer of the Vitrified Clay Pipe Publicity Bureau, Toronto; Industrial Safety, by R. B. Morley, secretary of the Industrial Accident Prevention Association, Toronto; Tunnel Kilns, by George Booth, of the Booth Brick & Lumber Co., Islington, Ont.; Handling Clay with Conveyors, by William Burgess of the Don Valley Brick Works, Todmorden, Ont.; Coal for Kiln Burning, by E. C. Hanson, consulting engineer, Toronto. The International Business Machines Co., Toronto, will give a paper on time and cost recording and a demonstration of the Hollerith tabulating and sorting machines operated by electricity. It is expected that Theodore Randall, secretary of the National Brick Manufacturers' Association and vice-president of the same association, will be present. The annual banquet will be held February 8.

The president of the C.N.C.P.A. is Ryland H. New of the Hamilton and Toronto Sewer Pipe Co., Hamilton. The secretary is G. C. Keith, 51 Wellington St. West, Toronto.

## BIGGEST BUILDING YEAR IN BRANDON, MAN.

Building permits issued in Brandon for ten months in 1921 total $742,190, or the highest total ever reached in the building history of the city in ten month's time. It is expected that the permits will quite easily slide over the three-quarters of a million dollars before the end of year, although November and December are counted as slow months as far as building activity is concerned.

The highest amount in any one month was in June, when the permits totalled $332,925, or nearly double the amount of the permits for any other month in the year. July showed next best with $176,475, while August's figures showed $159,000. These were the three big months of the year and practically accounted for the bulk of the record-breaking total.

This has been a bumper year in Brandon for the erection of public buildings. The new hospital, which will cost nearly $400,000 when completed is the largest of the buildings, and is followed by the Imperial Oil company plant, which was recently opened. The Winter Fair building, costing over $140,000 is another one of the big buildings erected in the city during the year, while the new Livingstone school, costing nearly $40,000, also provided work for a large number of men during the summer months.

Although 1920 was a large year in the building line, the building figures for that year totalled only $412,829.

## BUSINESS FOR THOSE WHO GO AFTER IT

Major Anthes, president of the Anthes Foundry, Limited, Toronto, Ont., has just returned from a two-months' busines strip through Western Canada. Major Anthes reports there is business to be had for those who go after it.

No. 30

## Canada's Contractors—F. E. Halls

One of the best known contracting firms in Western Canada is the Carter-Halls-Aldinger Company, Ltd., of which Mr. Frank Ernest Halls, whose portrait appears herewith, is a member. This firm is responsible for some of the finest structural work in the West, much of which has been described from time to time in the pages of the Contract Record. Examples are: the Vancouver station of the Canadian National Railways; the erection of the Winnipeg aqueduct, which was carried out in collaboration with the Northern Construction Co. at a cost of approximately $15,000,000; the Winnipeg drill hall and armoury; the Ford Motor Company's assembly plant at Winnipeg; the T. Eaton Company mail order department building, Winnipeg; the stores for the Hudson Bay Company, and for the Marshall-Wells Company, Ltd., at Winnipeg; Confederation Life Building, Winnipeg; Electric Railway Chambers, Winnipeg, etc.

Mr. Halls is secretary-treasurer of the company and his office is in the Union Bank Building. He is also secretary-treasurer of the Winnipeg Aqueduct Construction Co., and of the Walbridge Aldinger Company. He is an Ontario boy, having been born in Huron county in 1872. His early education was received in the county public schools and later in the University of Illinois. He was for some time general superintendent of construction of the Illinois Terra Cotta Company, Chicago, moving back to Canada in 1907, when his present company was formed fourteen years ago.

Mr. Frank E. Halls

### TORONTO BUILDERS' EXCHANGE HOLD SOCIAL EVENING

Toronto contractors demonstrated their ability to cope with other matters than construction when on November 30 they held a social evening under the auspices of the Toronto Builders Exchange and Construction Industries. The affair took the form of an informal dance and card party with buffet refreshments. A large turnout of members and their friends was present and it is safe to say that the members of the industry in Toronto are better acquainted with one another as a result of this social evening, which is a new venture on the part of the Builders' Exchange. It is hoped, however, that similar evenings will be arranged in future so that the builders of the city may become better known to one another.

### KERR ENGINE COMPANY APPOINT SALES REPRESENTATIVE

The Kerr Engine Company Limited, Walkerville, Ontario, manufacturers of Kerr valves, have recently appointed Mr. William R. Stavert, 58 Manning Chambers, Toronto, their sales representative covering territory from and including Hamilton, east to and including the province of Quebec. Mr. Stavert will represent the company in the sale of their products in the territory mentioned, with the exception of their radiator valves and waterworks business, which will still be handled direct from the office at Walkerville. Mr. Stavert was, until recently, manager of sales for Jenkins Brothers, Limited, and resigned to engage in business as manufacturer's agent.

### EXPANSION OF MORRIS CRANE COMPANY

The Herbert Morris Crane & Hoist Company, Limited, with head office and factory at Niagara Falls, Ontario, have found it necessary to open a branch office in Hamilton, Ont., to take care of its large and increasing business in that city and the surrounding district. Mr. F. C. Simpson is resident engineer in charge of the new branch, which is located at 512 York Street.

### GROWTH OF THE ROAD BUILDING INDUSTRY

In less than a score of years the road building industry has become one of the largest on the continent. At present it forms the major part of the construction industry. There are now identified with the road industry 80,000 federal, state, county, township and city highway officials, 7,000 road contractors, 2,000 bridge contractors, 1,196 manufacturers and dealers in road building machinery and materials, 7,338 firms manufacturing highway transportation equipment, 25,000 civil, highway and chemical engineers, and 842 national, state, provincial and local highway associations and engineers and contractors' organizations.

A recent item in the Contract Record mentioned the cost of the proposed city of Chatham incinerator as $85,000. The city engineer of Chatham, Mr. C. H. R. Fuller, advises us that his estimate is much less than this, somewhere around $33,000. He expects that tenders will be called for this work some time in December.

# Mainly Constructional

### East and West—From Coast to Coast

The ratepayers at Windsor, Ont., will vote, at the coming annual elections, on a by-law authorizing the expenditure of $200,000 on the widening of Sandwich Street.

The Board of Control at Toronto have decided to submit to the citizens a scheme to amalgamate the existing hydro commission and transportation commission in one public utilities commission.

Several members of the staff of the City Engineer's Department, at Hamilton, received substantial salary increases recently. An addition to the staff was also made in the person of Mr. Hector Phillips, of London, Ont.

The Board of Trade at Vancouver, B. C., is chafing at the delay in the construction of the government drydock at that point, claiming that industrial expansion and port development is being retarded by the delay in this construction. The matter has been taken up with Ottawa.

The Hydro-electric Commission of Walkerville, Ont., is planning the erection of a $60,000 fireproof office building at the corner of Argyle Road and Wyandotte Street. Several architects of the Border Cities have submitted competitive designs and no delay is anticipated in the commencement of construction.

If the present plans of the London Division of the C.P.R. are carried out next year, 80 miles of new 100-lb. rails will be laid on the company's lines between Toronto and London. Appropriations for this new trackwork have been drawn up and submitted to the head office of the company at Montreal for approval.

A conference of several prominent engineers and brokers was held at the King Edward Hotel, Toronto, recently to consider the inauguration of the campaign to finance the construction of the proposed International Bridge between Windsor and Detroit. Mr. Charles E. Fowler, engineer, of New York, was the chief speaker and outlined the various details of the proposed project to the financial men present.

The official opening of the new Live Stock Arena at the Exhibition Grounds, Toronto, will take place soon. The opening will be celebrated by a large athletic meet, to be held under the auspices of the city and the Sportsmen's Patriotic Association. No definite date has been set, but it is expected the opening will take place about the middle of this month.

An American concern, the Weeks Engineering Corporation has decided to establish a Canadian plant at Welland, Ont. The Welland Machine and Foundries plant, on Victoria St., is to be taken over and equipped with new machinery. Additional buildings will be erected in the spring. This new industry, which will specialize in the production of boiler tubes, will employ a staff of from 75 to 100 men.

The Board of Trade at Calgary, Alta., are urging the Department of the Interior, at Ottawa, to continue the operations of survey parties on the William Pearce Irrigation Scheme throughout the winter months, so that the necessary data required to estimate the cost of this development will be available in the spring, thus eliminating the possibility of delay in the carrying on of operations during next year.

Among the important matters to be decided by the ratepayers of Kitchener, Ont., at the coming municipal elections, will be the consideration of a by-law authorizing the expenditure of a large sum of money for the purchase of a site and erection of a new city hall, and another bye-law to provide $63,000 for the extension of the street railway. Plans and models of the proposed new municipal building are being prepared.

A press dispatch states that the result of the inquest in connection with the recent flood in British Columbia places the responsibility for this disaster with the Britannia Mining & Smelting Company, which operates copper mines at Britannia. The item claims the cause of the flood was shown to be the construction of the railroad fill on the mountain behind the town, which is of such a nature as to cause the damming and ultimate overflow of mountain streams.

The huge memorial tower being erected at Montreal harbor, in honor of those who died in the service of the British Navy and the mercantile marine during the war, is nearing completion. The memorial stands on a commanding site overlooking St. Mary's current, and a large clock in the tower will be visible all over the harbor. The column is 121 ft. high and the face of the clock is 4 ft. wide. Mr. Paul Leclair of the Harbor Commission, designed the memorial, the corner stone of which was laid by the Prince of Wales on the occasion of his visit to Canada in the fall of 1919.

On Saturday, November 26th, the last rock obstruction in the new Chippawa Canal was blown up with a 1-ton charge of dynamite. Sir Adam Beck was on hand to witness this event and was accompanied by several newspapermen. All the broken rock has, by this time, been removed from the canal and the final concreting of the floor and walls will be completed within a few days. The canal, when working to capacity, will develop 650,000 h.p. The party after inspecting the canal in automobiles, which had been lowered to the floor level by derricks, had dinner at one of the hydro camps and later went to the Savoy Hotel, Niagara Falls, for tea.

## Personal

Mr. F. J. Ure has been appointed to the council of the London, Ont., branch of the Engineering Institute of Canada. Mr. Ure is city engineer of Woodstock, Ont.

M. D. Sensand de Levaud, of Paris, the inventor of the centrifugal system of manufacturing cast iron pipe, accompanied by his wife, was a visitor at the King Edward hotel, Toronto, recently.

E. L. Miles has received the appointment of County Engineer, to be combined with his regular duties as County Road Superintendent for the County of Victoria, Ontario. Headquarters will be located at Lindsay.

Mr. J. M. Miller, city clerk of Calgary, Alta., who recently returned from a trip to the leading cities of Canada and the United States, states that many cities in the latter country are adopting the City Manager system of municipal government.

## Obituary

Word has reached Canada of the death of Lord Mount Stephen, at Hatfield, Hertfordshire, England, at the age of 92. Deceased was one of the founders of the Canadian Pacific Railway, being president till 1888. Shortly after his retirement from the C. P. R., he returned to England, where he had resided up till the time of his death.

## Trade Incorporations

W. G. Cornell Company, Limited, with head office at Montreal, capital $50,000, to carry on the business of general contractors and engineers.

# CONSTRUCTIONAL ACTIVITY

## Period of November 30 to December 6, 1921

*Dominion Wide Service Exclusive to "Contract Record & Engineering Review"*

## Waterworks, Sewerage and Roadways

**Allenford, Ont.**
Construction of highway in Amabel Twp. is contemplated by Twp. Council. G. C. Wain, secy.-treas., Allenford.

**Burlington, Ont.**
Construction of sewers on Woodland, Burlington and Hager Aves, and Caroline and John Sts. is planned by Town Council. L. Sykes, clerk.

**Embro, Ont.**
West Zora Twp. Council plan construction of extensions to Murray and Martin drains. Allan Murray, Secy.-treas., Embro.

**Hamilton, Ont.**
City Council plan opening of new street from Aberdeen Ave. to West Hamilton.

**London, Ont.**
City will construct aerator and settling basin costing $10,000 on Horton St. E. V. Buchanan, Mgr. Utilities Commrs.

**McGillivray Creek, B.C.**
F. N. Sinclair, Chief Engr. Sumas Dyking Commrs., Kilgard. B.C., has plans and will receive tenders until Dec. 20th for culvert and pump house.

**Ottawa, Ont.**
City will construct tile pipe sewer on Chrystler Ave. at cost of $28,000 by day labor. A. F. Macallum, Commr. of Works.

**Petrolia, Ont.**
Ratepayers passed by-law authorizing expenditure of $42,000 for reservoir and pumps. James, Proctor & Redfern, Ltd., Engrs., 36 Toronto St., Toronto.

**St. Thomas, Ont.**
City Council plan construction of extension to waterworks in Yarmouth Heights. W. C. Miller, Engr.

**Tupperville, Ont.**
Chatham Twp. Council plan construction of Pardo, McDonald. Norton and Horse Shoe Creek drains. A. MacArthur, secy.-treas., Tupperville. W. G. McGeorge, Engr., Chatham, Ont.

### CONTRACTS AWARDED

**Montreal, Que.**
General contract for contruction of sewer at cost of $23,110 on Harvard Ave., from Monkland Ave. to Cote St. Luke Rd., for City is awarded to A. Di Cesar & Cie, 885 St. Catherine St. E.

City Council awarded general contract for construction of sewer at cost of $8,643 on Coronation St., from Terrebonne to Sherbrooke St., to A. Di Cesar & Cie, 885 St. Catherine St. E.

General contract for construction of sewer costing $5,770 on Berri St., Blvd. Guoin to St. Denis St., for City is awarded to C. Perluzzi, 26 Sevignac Lane.

**Saanich, B.C.**
General contract for materials for waterworks costing $69,409.38 for Saanich Municipal Council is awarded to Yarrows, Ltd., Esquimalt, B.C.

**Sumas, B.C.**
Contract for installation of pump costing $16,000 for Commrs. of Sumas Dyking District is placed with Canadian Fairbanks-Morse Co., Ltd., 1400 Broad St., Victoria.

## Railroads, Bridges and Wharves

**Burnaby, B.C.**
Construction of wharf costing $6,000 at foot of Queen's Ave., Burrard Inlet, is contemplated by Dom. Govt., Dept. Pub. Works.

**Cowichan, B.C.**
Construction of rly. extension 10 miles northward from present terminus on Cowichan Lake at estimated cost of $150,000 is contemplated by C. N. Rlys.

### CONTRACTS AWARDED

**Kaslo, B.C.**
Dept. Pub. Works, Dom. Govt., are repairing wharves at Kaslo and Mirror Lake at cost of $6,000 by day labor. P. E. Doncaster, architect, Kaslo, B.C.

**Moncton, N.B.**
Roofing and plumbing contracts for roundhouse costing $1,000,000 for C. N. Rlys. are awarded to Barrett Co., Ltd., 2021 St. Hubert St., Montreal, and T. Johnston & Co., Ltd., 895 Main St., Moncton.

## Public Buildings, Churches and Schools

**Hamilton, Ont.**
Erection of school in West Hamilton is contemplated by Board of Education. W. P. Thompson, clerk.

**La Tuque, Que.**
L. Venne, architect, 85 Osborne St., Montreal, is preparing plans for church and Presbytery to cost $300,000 for Parish. It was previously reported in error that Mr. Venne had been awarded the general contract.

**London, Ont.**
Plans will be prepared for Memorial Hall to cost $50,000 for Congregation of First Methodist Church. Jno. H. Chapman, Chrm. of Trustees, 522 King St.

**Ottawa, Ont.**
Erection of Community Hall is contemplated by Rotary Club of Ottawa. Interested, Fred D. Burpee, Mgr. O. E. Rly. Co., Albert St.

**Shaunavon, Sask.**
Erectiin of Memorial Hall is contemplated by G.W.V.A., Shaunavon. G. A. Stubbings, secy.-treas. Bldg. Committee.

**Toronto. Ont.**
St. Aidan's Anglican Church will erect hall costing $65,000 at Silverbirch Ave and Queen St. A. J. Stringer, architect, 53 MacLean Ave.

Bloor St. Baptist Church, Bloor and North Sts., plan erection of church. Rev. W. A. Cameron, Selby Apts., Grosvenor St.

**Wellington, Ont.**
S. B. Coon & Son, architects, 4 St. Thomas St., Toronto, have plans and will receive tenders until Dec. 20th for reinforced concrete brick and stone work, hollow tile, structural steel, ornamental iron, steel casements, carpentry, plastering, painting, glazing, heating and ventilation, plumbing, electric wiring, roofing, galvanized iron and terrazzo, for consolidated school costing $97,800 for School Bd. Marked cheque for 2½% must accompany each tender.

**Windsor, Ont.**
D. J. Cameron, architect, 5 Bartlett Bldg., Windsor, has plans and will receive tenders until Dec. 10th (time extended) for erection of Technical School costing $450,000 for Windsor and Walkerville School Bds. Structural plans also with MacLean Building Reports, Ltd., 345 Adelaide St. W., Toronto. Mechanical plans and specifications with H. H. Angus, Mechanical Engr., Continental Life Bldg., Toronto.

### CONTRACTS AWARDED

**Cap de la Madeleine, Que.**
Nap. Montplaisir, Cap de la Madeleine, has electrical contract for fire station costing $20,000 for City.

**Hamilton, Ont.**
Roofing contract for sanitorium costing $55,000 for Hamilton Health Assn., care of Sanitorium Mountain Top, Hamilton, is awarded to Irwin & Son, 22 McNabb St. S. Contract for sanitary and toilet work is placed with Standard Sanitary Mfg. Co., Ltd., 22 Jackson St.

**London, Ont.**
Noble & Rich, 237 Queens Ave., have plumbing and heating contracts for alterations to bldg. for children's shelter costing $65,000 for Salvation Army. Painting contract is placed with Paul Quick, 717 Maitland St.

**Marieville, Que.**
Additional contracts for hospital for Les Soeurs de la Charite de l'Hospice, St. Croix de Marieville, are: Plastering, G. Rochefort, 108D Stadacona St., Montreal; marble and tile, Lepage Marble Works, Ltd., 734 St. Lawrence Blvd., Montreal; roofing and ventilators, M. Chouinard, 751 Adam St., Montreal.

**Montreal, Que.**
Millwork contract for alterations to church costing $10,000 on St. Zotique St. for St. Alban's Parish is awarded to Jas. Davidson's Sons, Wellington St., Ottawa, Ont.

**Simcoe, Ont.**
Roofing contract for church costing $40,000 for Baptist Church Congregation is awarded to Brown & Jarvis.

**St. Laurent, Que.**
Additional contracts for school costing

ESTABLISHED 1886

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## *"Rings" Among Building Supply Dealers*

"Rings" in the building industry that participate in pernicious operations in restraint of fair trade should not be tolerated in the slightest degree, and a punishment should be meted out to participants sufficiently severe as to make the practice too risky to have any hope of success. At various times the existence of such rings has been disclosed and it is even alleged by investigators that in one or two of our cities to-day honest competition is being stifled by the activities of groups of supply men who violate every law of fair business. The methods by which these wolves of the building industry carry on their pernicious practices may best be described in the words of Judge Van Fleet who in New Work City recently sentenced four offenders of this character to jail terms and fined forty-eight others in amounts up to $5,000 for being members of a tile and mantel trust. Judge Van Fleet analyzes and condems four outstanding practices in these words:

"The first of these practices was the 'stop notice' scheme by which one tile company would notify all others to break off all dealings with a given contractor till that contractor had met the terms of the tile company issuing the 'stop notice.'

"The second of these practices was the so called 'protection card.' This practice was originated and utilized by a group of several among the defendants who were more or less the leaders in the business. Upon the request of any one member, the secretary would circulate among other members a notice card giving the location of the job and the name of a contractor who either had awarded a contract or was about to award a contract for tile work. This card was in sum and substance a notice to the other members to ignore that contractor and not to bid upon work he required to be done, leaving the field clear for the member who had requested the protection card, so that he might secure not only the contract for the original work, but for any extra or additional work necessary to complete it—and this upon his own terms. It left the builder completely at the mercy of the individual defendant as to price and all other terms and conditions of the contract.

"The next provision was the 'keep off' notice, which some of the leading members utilized through the medium of the secretary, when they desired other members to refrain from bidding upon a prospective job.

"Finally, there was the blacklisting or collection system known in the association as 'forms No. 1,2, and 3.' Under this practice of collecting alleged debts, the defendants were not content with the usual processes of the law. If any member of the combination made a claim against a contractor for moneys claimed to be due, whether it was just or unjust, the contractor was served with notice to appear before a committee of the organization to act as his judges and on his failure to make appearance he was promptly blacklisted.

"Thereupon he became a marked man among the members of this combination. Any bids he thereafter requested were without his knowledge arbitrarily increased by the secretary of this association and the moneys claimed to be due any member of the combination were in that way collected through this method of fraudulent bidding; and in some instances the amount claimed to be due was collected more than once and from persons who never could have incurred the indebtedness because they had had no part or parcel in the original transaction out of which the alleged claim arose.

"Finally, the plea of the defendants admits, as alleged in this fourth count, that they indulged in wholly vicious and unjustifiable practice of what is known as accommodation bidding; that is, they would previously determine who of their number was to receive a particular contract and then collusively arrange their bids so that the transaction, while it appeared to the contractor receiving the bids as being competitive, would not be so in fact."

Fortunately, practices of this character do not readily make headway in Canada, but from time to time there are rumors of the existence of rings, the allegations being often proven without foundation. However, should there be any evidence of trade restraints of this kind, it will be for the good of the industry and for the improvement of its relations with the general public, if the facts are exposed and brought to the attention of the government.

## *Considerable Building in Sherbrooke, P. Q.*

The city of Sherbrooke is showing a very encouraging activity in building and construction at the present time. St. Charles College is making an extension to cost $5,000. J. Guay is building a duplex residence on Murray Street, costing $10,000. The Corporation Episcopal of Sherbrooke is erecting a chapel on Cummings Street, at a cost of $12,000, and Ed. Bradley will erect four apartments and three stores on Frontenac Street, at a cost of $15,000.

Real estate men in Toronto are reporting an extra heavy sale of residence sites in various sections of the city.

*No. 73*

## *Canada's Engineers—W. V. Taylor*

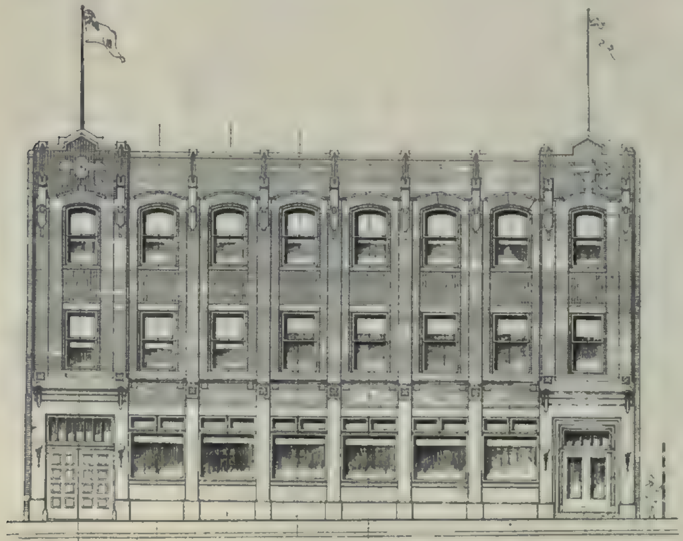
**William Verner Taylor, who succeeded Mr. John A. Baird as city engineer of Sarnia, Ont., early in this year, was born in 1873 and graduated in civil engineering from the University of Toronto at the age of twenty. .Fof two years following his graduation, he studied land surveying under articles, taking an appointment in 1896, as assistant engineer for the town of Deseronto and Bay of Quinte Railway In 1897 he qualified as an Ontario Land Surveyor and in the same year took up a short course in mining at Queen's University, following up this training by surveying mining locations. Mr. Taylor then became associated with railroad work and for a number of years filled various positions in the engineering departments of several Canadian railway companies. His first appointment of this nature was in 1898, when he served as instrument man in British Columbia on the construction of the Columbia and Western Railway two years later becoming resident engineer for the C. P. R. on the construction of branch lines near Winnipeg. In 1901 he was engaged in locating lines for the electric railway of St. Catharines, Ont., and then became resident engineer on the Algoma Central Railway construction. From 1902 to 1906 Mr. Taylor was assistant engineer on construction of the Montreal Locomotive Works, engaged on maintenance, structural design, detail and fabrication of extensions, etc. Following his service in this capacity, he became chief draughtsman of the Dominion Engineering & Construction Company and then for two years was engineer for the St. Lawrence Stevedoring Company, installing coal handling plants. In 1910 he became assistant chief engineer of the Quebec Harbor Commission and was engaged on this work until his acceptance of the position of city enginer of Sarnia this year. Mr. Taylor is a full member of the Engineering Institute of Canada and also a member of the Corporation of Professional Engineers of Quebec.**

Mr. W. V. Taylor

# New City Office at Sherbrooke

By Our Sherbrooke Correspondent

Sherbrooke is also going to own new office premises of its own pretty soon. A new municipal building costing $75,000 is being erected on Wellington Street North, on a lot owned by the city, next to "His Majesty's Theatre." The new building, erected also according to plans and specifications furnished by Mr. J. W. Gregoire, architect, is to be of fireproof construction throughout with reinforced concrete frame and solid brick walls, the facade being of granite, hard pressed grey brick and ornamental stone work. The building is 60 ft. by 80 ft., three storeys high. with a 20 ft. by 18 ft. two storey high fireproof vault at the rear of the main building.



Sherbrooke's Municipal Block

General offices are on the ground floor, while the city council assembly room committee rooms and city engineer's offices are located on the first floor, the second floor being used for public hall and offices.

The building is provided with a hot water, gravity system of heating, modern electric wiring and appliances, terrazzo floors in halls and public access to general offices, and iron stairs with marble steps The general contract was awarded to the Sherbrooke Construction Co. Ltd., Sherbrooke, for some $70,000 for the building; excavations, which are in rock, are being made by day work at the city's expense. The contract is to be completed next summer.

### Unemployment is Reduced

According to the November issue of the Labour Gazette, reports received from over 5,000 employers indicate that employment was in somewhat greater volume during October than in the preceding month, although the situation continued to be decidedly less favourable than during October of last year.

### Steel for Mount Royal Hotel

The Dominion Bridge Company, who have the contract for supplying steel for the Mount Royal Hotel, Montreal, are now making delivery of structural parts.

# Construction Developments During November

## Figures Compiled by MacLean Building Reports, Ltd., Show Trend of Building Activities for Last Month—Details of Contracts Awarded

Construction activity in November, according to figures published by MacLean Building reports, Limited, amounted to $16,639,800, compared with $18,997,200 in October, and $15,399,200 in November, 1920. The totals for the different provinces are shown in the accompanying tables.

Work reported during November, for the first time, as contemplated, totalled $13,998,600. The figures are shown in detail in the tables herewith.

### Active Building Looked For

The recession in prices of both building material and labor which started several months ago, still continues, states the Canadian Building Review, published by MacLean Building Reports. Ltd. Demands for new construction are still piling up. Prominent builders, supply dealers, students of the whole building situation, and statistical compilations, imply that a resumption of active building operations should not be long delayed. The chief obstacle in the path of brisk building is absence of ready money, but this difficulty will be surmounted in the general decline in cost of completed buildings. Loan companies are closely studying the descent in prices and calculating where the new level will be found, in order to establish a sound lending basis, which has been impossible during the years immediately following the war, when inflated valuations prevailed. The conservative policy adopted by the loan companies during the past two years, while working a severe hardship on the trade, has been justified, as they could not be expected to finance new construction at prices above the valuations the buildings would bring after the period of inflation was over.

### The Labor Situation Clearing

Outstanding declines in material have been recorded in lum-

### Construction Contracts Awarded in Eastern Canada, November, 1921

| | Ontario | | Quebec | | New Brunswick | | Nova Scotia | | Eastern Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 3 | $ 112,000 | [illegible] | $ 203,000 | .... | .... | 1 | $ 5,000 | 8 | $ 320,000 |
| Churches | 3 | 93,400 | 1 | 10,000 | .... | .... | .... | .... | 4 | 103,400 |
| Factories | 15 | 1,074,500 | 1 | 3,000 | 1 | 10,000 | .... | .... | 17 | 1,087,500 |
| Public Garages | 25 | 276,000 | 14 | 70,400 | .... | .... | 3 | 10,000 | 42 | 356,400 |
| Hospitals | [illegible] | 162,500 | .... | .... | .... | .... | .... | .... | 2 | 162,500 |
| Hotels and Clubs | 5 | 138,000 | 1 | 35,400 | .... | .... | 1 | 6,000 | 7 | 179,400 |
| Office Buildings | 7 | 64,000 | 2 | 85,000 | 1 | 3,000 | 1 | 2,000 | 11 | 154,000 |
| Public Buildings | 1 | 5,000 | 2 | 340,300 | 1 | 11,600 | 1 | 7,500 | 5 | 364,400 |
| Residences | 88 | 4,663,300 | 455 | 1,767,600 | 5 | 47,000 | 19 | 83,900 | 1362 | 6,561,800 |
| Schools | 7 | 808,000 | 5 | 207,500 | 1 | 15,000 | 1 | 12,000 | 14 | 1,042,500 |
| Stores | [illegible] | 643,500 | 17 | 223,900 | 1 | 8,000 | 3 | 26,000 | 80 | 901,400 |
| Theatres | 1 | 40,000 | 1 | 4,000 | .... | .... | 1 | 14,000 | 3 | 58,000 |
| Warehouses | 11 | 82,000 | 15 | 72,200 | .... | .... | 1 | 3,800 | 27 | 158,000 |
| Total Buildings | 1022 | $8,162,200 | 518 | $3,022,300 | 10 | $ 94,600 | 32 | $ 170,200 | 1582 | $11,449,300 |
| Bridges | 1 | $ 2,100 | 3 | $ 203,500 | 1 | $ 60,000 | .... | .... | 5 | $ 265,600 |
| Dams and Wharves | [illegible] | 105,600 | 3 | 21,700 | 1 | 7,500 | 1 | $ 10,000 | 11 | 144,800 |
| Sewers & Waterm'ns | 8 | 236,500 | 3 | 18,600 | .... | .... | .... | .... | 11 | 255,100 |
| Roads and Streets | 24 | 303,600 | .... | .... | .... | .... | .... | .... | 24 | 303,600 |
| General Engineering | 11 | 3,015,000 | 1 | 10,000 | .... | .... | .... | .... | 12 | 3,025,000 |
| Grand Total | 1072 | $11,825,000 | 528 | $3,276,100 | 12 | $ 162,100 | 33 | $ 180,200 | 1645 | $15,443,400 |

### Construction Contracts Awarded in Western Canada, November, 1921

| | British Columbia | | Alberta | | Saskatchewan | | Manitoba | | Western Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 1 | $ 12,500 | .... | .... | .... | .... | .... | .... | 1 | $ 12,500 |
| Churches | 2 | 5,000 | 4 | $ 40,800 | .... | .... | .... | .... | 6 | 45,800 |
| Factories | 3 | 16,700 | .... | .... | 3 | $ 37,500 | 2 | $ 19,000 | 8 | 73,200 |
| Public Garages | 1 | 3,000 | 1 | 10,000 | .... | .... | .... | .... | 2 | 13,000 |
| Hospitals | .... | .... | .... | .... | .... | .... | 2 | 23,000 | 2 | 23,000 |
| Hotels and Clubs | 1 | 7,000 | .... | .... | .... | .... | .... | .... | 1 | 7,000 |
| Public Buildings | 1 | 30,000 | .... | .... | .... | .... | .... | .... | 1 | 30,000 |
| Residences | 107 | 404,400 | 19 | 57,200 | 31 | 105,200 | 16 | 42,100 | 173 | 608,900 |
| Schools | 1 | 16,000 | 3 | 17,800 | 2 | 7,900 | 2 | 10,000 | 8 | 51,700 |
| Stores | 12 | 88,600 | .... | .... | 3 | 38,200 | 7 | 43,500 | 22 | 170,300 |
| Theatres | 2 | 26,000 | .... | .... | .... | .... | .... | .... | 2 | 26,000 |
| Warehouses | 3 | 11,500 | 2 | 14,000 | 1 | 1,000 | .... | .... | 6 | 26,500 |
| Total Buildings | 134 | $ 620,700 | 29 | $ 139,800 | 40 | $ 189,800 | 29 | $ 137,600 | 232 | $1,087,900 |
| Bridges | 2 | $ 16,000 | .... | .... | .... | .... | .... | .... | 2 | $ 16,000 |
| Sewers & Waterm'ns | 1 | 29,800 | .... | .... | 1 | $ 5,000 | 1 | $ 4,000 | 3 | 38,800 |
| Roads and Streets | .... | .... | .... | .... | .... | .... | 1 | 23,700 | 1 | 23,700 |
| General Engineering | 1 | 30,000 | .... | .... | .... | .... | .... | .... | 1 | 30,000 |
| Grand Total | 138 | $ 696,500 | 29 | $ 139,800 | 41 | $ 194,900 | 31 | $ 165,300 | 239 | $1,196,400 |

### Contemplated New Construction Work in Canada, November, 1921

| | Ontario | | Quebec | | Maritime | | Western | | Dominion | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value | No. | Value |
| Apartments | 2 | $ 60,000 | .... | .... | .... | .... | .... | .... | 2 | $ 60,000 |
| Churches | 5 | 130,000 | 4 | $ 215,000 | 1 | $ 25,000 | .... | .... | 10 | 370,000 |
| Factories | 15 | 1,510,000 | 3 | 303,000 | .... | .... | 3 | $ 540,000 | 21 | 2,353,000 |
| Public Garages | 4 | 78,000 | 2 | 40,000 | 2 | 50,000 | 2 | 20,000 | 10 | 188,000 |
| Hospitals | 1 | 8,000 | 1 | 100,000 | .... | .... | 1 | 3,000 | 3 | 111,000 |
| Hotels and Clubs | 4 | 80,000 | 1 | 75,000 | 2 | 60,000 | 4 | 137,000 | 11 | 352,000 |
| Office Buildings | 1 | 30,000 | 1 | 25,000 | .... | .... | 3 | 158,000 | 5 | 213,000 |
| Public Buildings | 7 | 575,000 | 2 | 356,000 | 1 | 30,000 | 7 | 181,200 | 17 | 1,142,200 |
| Residences | 118 | 728,300 | 226 | 1,349,500 | 1 | 10,000 | 71 | 276,000 | 416 | 2,363,800 |
| Schools | 12 | 1,304,000 | 5 | 113,500 | 1 | 100,000 | 10 | 77,300 | 28 | 1,594,800 |
| Stores | 11 | 204,000 | 7 | 85,000 | .... | .... | 3 | 31,000 | 21 | 320,000 |
| Warehouses | 9 | 595,000 | 3 | 35,000 | .... | .... | 1 | 25,000 | 13 | 655,000 |
| Total Buildings | 189 | $5,302,300 | 255 | $2,697,000 | 8 | $ 275,000 | 105 | $1,448,500 | 557 | $9,722,800 |
| Bridges | 1 | $ 20,000 | 2 | $ 38,000 | .... | .... | .... | .... | 3 | $ 58,000 |
| Dams and Wharves | 2 | 90,000 | .... | .... | 1 | $ 17,000 | .... | .... | 3 | 107,000 |
| Sewers & Waterm'ns | 28 | 942,000 | 3 | 66,900 | .... | .... | 3 | $ 16,000 | 29 | 1,024,900 |
| Roads and Streets | 15 | 682,400 | 4 | 120,000 | .... | .... | 1 | 30,000 | 20 | 832,400 |
| General Engineering | 6 | 245,000 | 5 | 251,000 | 3 | 212,500 | 4 | 1,545,000 | 18 | 2,253,500 |
| Grand Total | 236 | $7,281,700 | 269 | $3,172,900 | 12 | $ 504,500 | 113 | $3,039,500 | 630 | $13,998,600 |

## Comparative Statement of Contracts Awarded in Canada

| According to Geographical Divisions | Ontario | Quebec | Maritime | Western | Total |
|---|---|---|---|---|---|
| November, 1921 | $ 11,825,000 | $ 3,276,100 | $ 342,300 | $ 1,196,400 | $ 16,639,800 |
| November, 1920 | 3,902,800 | 3,453,900 | 1,251,300 | 6,791,200 | 15,399,200 |
| November, 1919 | 7,481,100 | 4,983,700 | 1,166,500 | 3,323,900 | 16,955,200 |
| November, 1918 | 1,338,400 | 728,200 | 607,000 | 463,300 | 3,136,900 |
| 11 months, 1921 | 104,895,100 | 58,341,600 | 7,942,800 | 49,835,300 | 221,014,800 |
| 11 months, 1920 | 106,134,500 | 50,469,000 | 21,001,800 | 69,253,700 | 246,859,000 |
| 11 months, 1919 | 82,507,500 | 53,345,200 | 18,123,900 | 27,362,300 | 181,338,900 |
| 11 months, 1918 | 31,983,100 | 23,641,700 | 22,855,100 | 16,563,100 | 94,562,200 |

| According to Classifications or Types | Residential | Business | Industrial | Engineering | Total |
|---|---|---|---|---|---|
| November, 1921 | $ 7,503,200 | $ 3,873,300 | $ 1,160,700 | $ 4,102,600 | $ 16,639,800 |
| November, 1920 | 3,137,900 | 3,591,900 | 2,409,600 | 6,259,800 | 15,399,200 |
| November, 1919 | 4,591,300 | 5,033,700 | 6,055,000 | 1,275,200 | 16,955,200 |
| November, 1918 | 848,200 | 1,308,200 | 618,200 | 362,300 | 3,136,900 |
| 11 months, 1921 | 72,169,400 | 80,305,700 | 16,029,600 | 52,510,100 | 221,014,800 |
| 11 months, 1920 | 53,368,700 | 83,244,100 | 64,281,200 | 45,965,000 | 246,859,000 |
| 11 months, 1919 | 44,390,100 | 56,304,200 | 54,634,100 | 26,010,500 | 181,338,900 |
| 11 months, 1918 | 14,114,600 | 24,031,500 | 37,612,400 | 18,803,700 | 94,562,200 |

**CONTRACTS AWARDED ACCORDING TO CLASSIFICATIONS, JANUARY TO NOVEMBER (INCLUSIVE), 1921.**

| | Ontario | | Quebec | | Maritime | | Western | |
|---|---|---|---|---|---|---|---|---|
| | No. | Value | No. | Value | No. | Value | No. | Value. |
| Residential Buildings | 8819 | $41,596,900 | 2998 | $16,199,100 | 467 | $2,229,900 | 3058 | $12,143,500 |
| Business Buildings | 1221 | 33,764,600 | 685 | 28,142,800 | 167 | 3,331,600 | 999 | 15,066,700 |
| Industrial Buildings | 106 | 6,161,300 | 62 | 3,147,000 | 11 | 300,000 | 50 | 6,421,300 |
| Public Works and Utilities | 459 | 23,372,300 | 276 | 10,852,700 | 72 | 2,081,300 | 274 | |

ber, brick and steel, while enameled plumbing fixtures have consistently refused to join the backward swing and remain practically at peak prices. Labor has reluctantly joined in the downward trend, but only to a slight degree. Further declines will materialize, despite the strenuous efforts of union officials to maintain present schedules. No one expects wages to return to pre-war levels, but rather would insist that all departments in the trade be justly paid in accordance with ability and ratio with the cost of living. It is evident that labor is responding to the demand that it shall render a fair day's work for the wage it receives, and the old practices of petty strikes, slowing up the gang, deliberate limitation of production, and many other non-productive tactics, are vanishing.

### Now is the Time to Plan for Building

Under these favorable conditions for the builder and the general outlook for better things, he may wisely prepare his building program to take advantage of the rare building opportunity which is near at hand. He should set his architect to work during the winter months in the preparation of plans and specifications, in order to be in a position to launch his project at the opportune moment. The law of supply and demand will assert itself when the general activity, which is freely predicted for the near future, becomes a reality, and a tendency to increased building costs will again be in order.

# Trend in Building Material Prices

## A Comparison of Present Day Commodity and Labor Costs with Pre-war and Peak Prices—The Contract Record's Index

How does the cost of building, to-day, compare with pre-war prices and with the peak prices of 1920?

This is a question that is asked daily and one to which it is difficult to give an accurate reply. There are many factors to be considered. It is not only the prices of the materials, labor and overhead that must be compared, but also the extent to which every item under each one of these headings enters into the cost of a building. Every one of these factors is variable and every one of them varies according to a law of its own.

Nevertheless, something can be learned by a mere comparison of prices and the following table will be of interest. It gives comparative figures for July 1, 1914, September 1, 1920, and December 1, 1921, taken from the Contract Record's "Current Prices". The July 1, 1914, figure is taken as the base in every case. There is no real reason for choosing July 1, 1914, as the base date except that it was immediately preceding the outbreak of the war and was in the height of the building season of that year. September 1, 1920, has been chosen as representing the peak of building costs. The peak is frequently taken as somewhat earlier in that year, perhaps July 1, but a study of quotations indicates that there were practically no price recessions before September 1, while in a few cases the peak was only reached about that date.

| | July 1, 1914 | Sept. 1, 1920 | Dec. 1, 1921 |
|---|---|---|---|
| **Materials:** | | | |
| Cement | 100 | 232 | 200 |
| Lime | 100 | 219 | 175 |
| Brick (Dry Pressed) | 100 | 188 | 176 |
| Brick (Common Stock) | 100 | 164 | 171 |
| Crushed Stone | 100 | 187 | 174 |
| Sand | 100 | 150 | 140 |
| Gravel | 100 | 180 | 180 |
| Rubble Stone | 100 | 174 | 213 |
| Hemlock | 100 | 262 | 166 |
| Pine | 100 | 234 | 167 |
| Shingles | 100 | 292 | 180 |
| Lath | 100 | 400 | 255 |
| Dimension Timber | 100 | 250 | 188 |
| Steel (Reinforcing) | 100 | 220 | 120 |
| Steel (Structural Shapes) | 100 | 232 | 136 |
| Cast Iron Pipe | 100 | 242 | 182 |
| Plaster | 100 | 263 | 312 |
| White Lead | 100 | 237 | 155 |
| **Labor:** | | | |
| Bricklayers | 100 | 182 | 182 |
| Plumbers | 100 | 200 | 200 |
| Painters | 100 | 214 | 214 |
| Electrical Workers | 100 | 219 | 219 |
| Capenters | 100 | 200 | 178 |
| Common Labor | 100 | 183 | 150 |

# Tests on Angle Brackets Conducted by Dominion Bridge Co.

## Study of Several Types Was Undertaken in Order to Determine Economies in Weight and Methods of Fabrication—Welded as Well as Riveted Brackets Were Tested

By ALEXANDER PEDEN, A.M.E.I.C., Dominion Bridge Co., Montreal.

During the winter of 1920-1921, a committee was appointed by the Dominion Bridge Company to study standard details for further economies in weight and methods of fabrication. In the month of March, 1921, a series of tests was undertaken to determine actual data for bracket angles, without stiffeners. Three 8 x 8 H-columns were prepared with both flange and web brackets so arranged that each column had only one thickness of angle; thus one column had shelf angles ½ in. thick, another ⅝ in. thick, and the third had angles ¾ in. thick. Rivets ¾ in. in diameter were used throughout and each column contained brackets as follows:—One flange bracket of one 6 in. x 3½ in. angle, 5½ in. long, with 4 rivets and standard lock angle; one flange bracket of one 8 in. x 3½ in. angle, 5½ in. long, with 6 rivets and standard lock angle; two web brackets each of one 8 in. x 3½ in. angle.

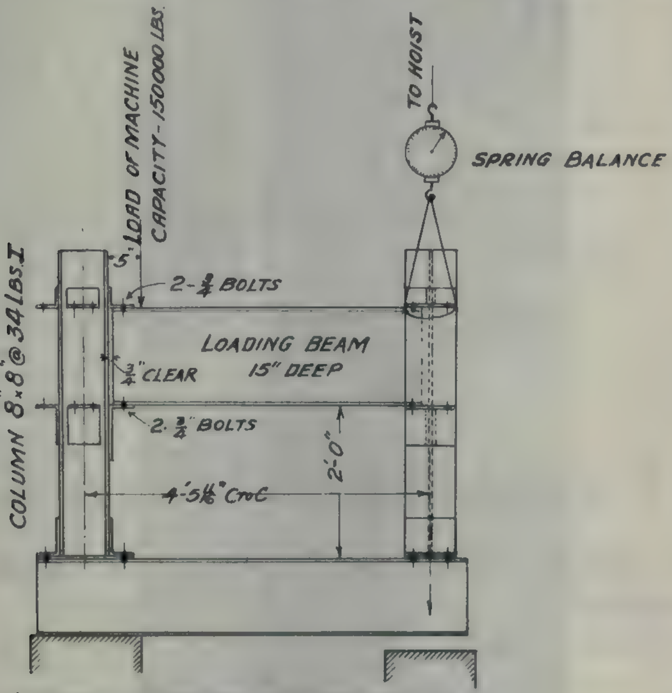


DIAGRAM SHOWING ARRANGEMENT OF TEST PIECES IN TESTING MACHINE

Fig. 1.

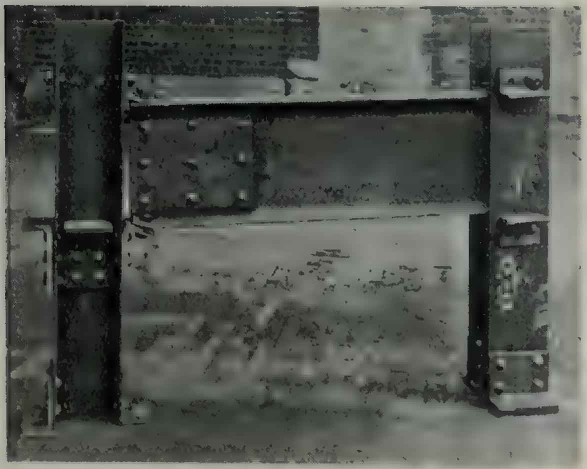


Fig. 2– General view of test column with beam in place as arranged for testing machine

When applying the load during tests, actual working conditions were very closely approached by transferring it through a beam; then the maximum eccentricity due to possible clearances was taken care of by facing the beams to obtain a full ¾ in. clearance between the end of the beam and the column face.

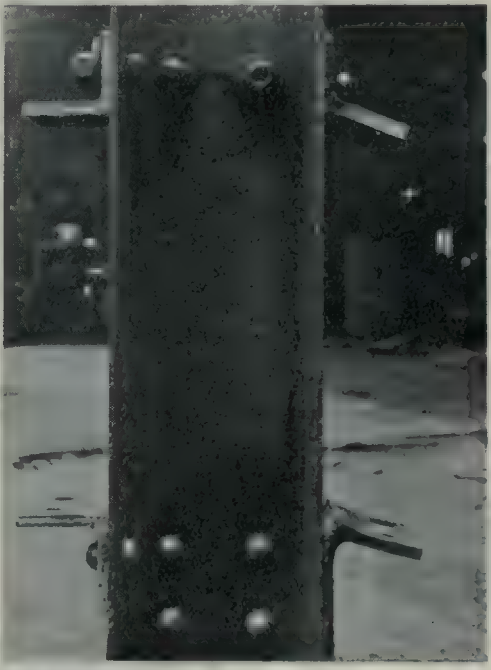


Fig. 3—Welded bracket: First perceptible crack in weld appeared when load of 49,500 lbs. was applied, while the ultimate load was 116,000 lbs. Welding across the top would increase the value enormously.

The experiments were carried out in the McGill university engineering laboratory and the Emery hydraulic testing machine with a capacity of 150,000 lbs. was used. Figure 1 is a diagram showing the arrangement of test pieces as placed in the testing machine.

Descriptions of the tests follow:—

Test 1.—

Bracket shelf angle, 6 in. x 3½ in. x ½ in.; loading beam, 15 in. at 42 lb. I. The load was applied in increments of 10,000 lbs. and the first

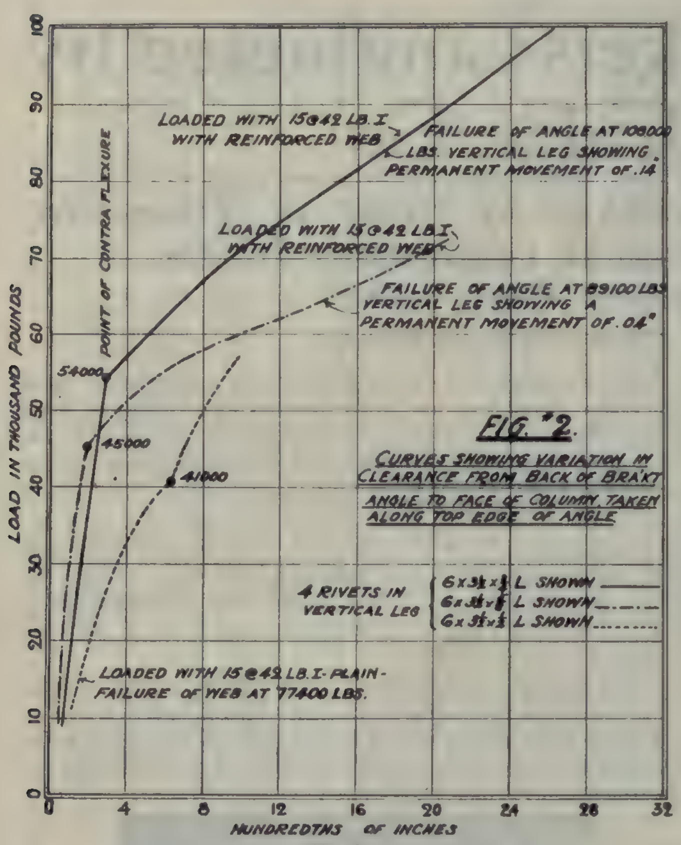


Fig. 4

change in position of material occurred at the root of the angle by a minute increase in the clearance between the vertical leg and the column. This was measured with feelers, the results being plotted in figure 4. The second feature to develop was a bending in the shelf angle between loads of 40,000 to 45,000 lbs. However, the experiment was continued and failure developed at a load of 77,400 lbs. Before making further tests, the pieces were carefully examined and this located the failure in the beam web close to the bottom flange.

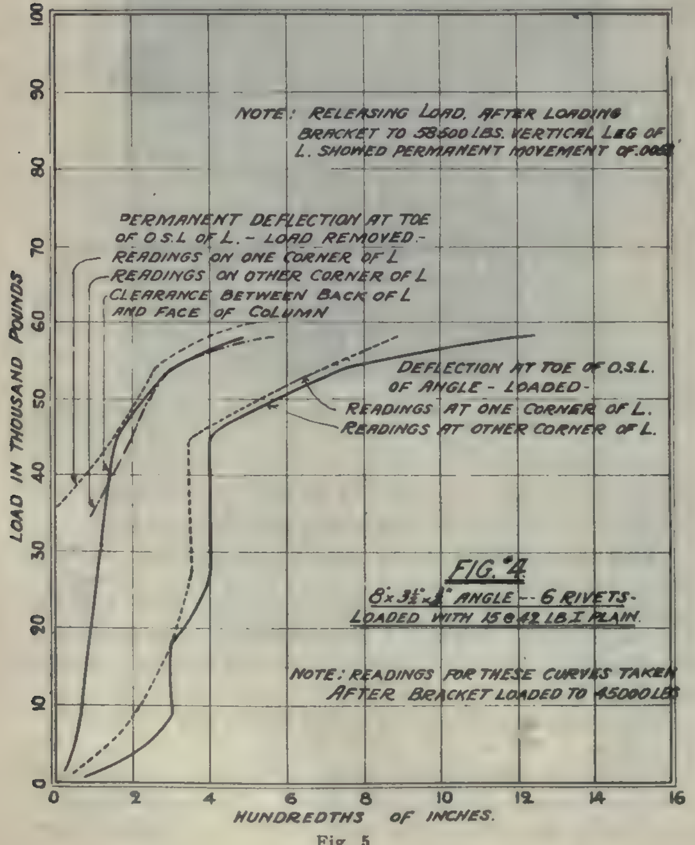


Fig. 5

Test 2:—

Bracket shelf angle 6 in. x 3½ in. x ⅝ in.; loading beam, 15 in. at 42 lb. I, reinforced with 5/16 in. web plates not fitted. All features of the first test were repeated with the exception that the angle stood up better and a noticeable clearance did not develop until after 45,000 lbs. had been applied. Ultimate failure occurred at a load of 89,100 lbs.

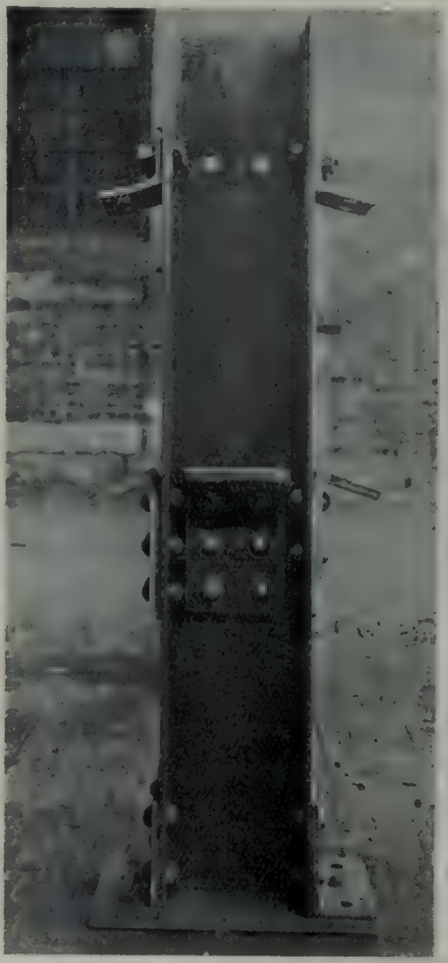


Fig. 6 -Specimen column with ⅝" angle brackets. The 6" angle bracket with four rivets supported beam until load of 89,000 lbs. was applied. The extra rivets in the 8" angle bracket did not increase value of bracket.

Test 3:—

Bracket shelf angle 6 in. x 3½ in. x ¾ in; loading beam, 15 in. at 42 lb. I, reinforced as above. There was noticeable clearance after application of 54,000 lb. load. Ultimate failure took place at 108,000 lbs. load.

**Test Results in Brief**

| | | | |
|---|---|---|---|
| Angle thickness | ½ in. | ⅝ in. | ¾ in. |
| Point of contraflexure or permanent set | 41,000 | 45,000 | 54,000 |
| Clearance at root of angle for this load | .0615 in. | .02 in. | .025 in. |
| Ultimate failure | 77,400 | 89,100 | 108,000 |

Rivet failures have not been mentioned as none

**8 x 3½ x ⅝ angle loaded with a 15″ @ 60 lb. I, with reinforcing plates ground to fit fillets**

| Load | Clearance between back of angle and face of column | Movement of vertical leg of angle Howard gauge readings |
|---|---|---|
| 9,000 | 0. | no readings |
| 18,000 | 0. | no readings |
| 27,000 | 0. | .0009 |
| 36,000 | .010 | .0020 |
| 45,000 | .016 | .0042 |
| 54,000 | .018 | .0054 |
| 63,000 | .025 | .0079 |
| 72,000 | .047 | .0106 |
| 81,000 | .060 | .0128 |
| 90,000 | .099 | .0154 |
| 99,000 | .130 | .0189 |
| 108,000 | .247 | no readings |
| 116,370 | angle failed | with load reduced showed permanent movement of .0268 |

At this load column had quite a noticeable bend.

developed. Failure apparently occurred before the shearing value of the rivets plus the friction on the face of the column could be overcome. The movement of the angles on the column face was negligible. At point of ultimate failure this was .04 of an inch for the ⅝ in. angle and .14 of an inch for the ¾ in. angle.

Some further tests were taken in a more elaborate manner, the results of some of which are tabulated in table 1, and indicated in figure 5.

The latter shows the action of a 8 in. x 3½ in. x ¾ in. angle, loaded with a 15 in. at 42 lb. I-beam, while in table 1 are stipulated the results of tests on a 8 in. x 3½ in. x ⅝ in. angle loaded, with a 15-in. at 60-lb. I-beam, reinforced with web plates which were ground to fit the fillets. In this case the angle failed at a load of 116,000 lbs., but at this load a flange of the beam was badly crushed against the reinforcing plates. Other tests included an experiment on a standard bracket with stiffeners, consisting of a 6 in. x 3½ in. x ⅜ in. shelf angle and stiffeners of two 3 in. x 2½ in. x 5/16 in. angles with 6 rivets and a test on two brackets of 8 in. x 3½ in. x ¾ in. angles loaded equally on both sides to determine the action of the rivets in bearing on the web of the column.

These results would clearly indicate that a bracket with a 6 in. x 3½ in. x ⅝ in. shelf is capable of taking a reaction of at least 25,000 lbs.

### Welded Bracket

A test was also made on a bracket consisting of a shelf of 6 in. x 3½ in. x ½ in. angle and 3½ in. x 3 in. x ⅜ in. lock angle electrically welded to the flange of the column. The shelf angle was welded only around the sides and bottom, the top edge not being welded. The load was applied as in Figure 1, the loading beam used being a 15 in. at 60 lb. I with 5/16 in. reinforcing plates on the web fitted into the fillets of the beam. As the load was applied the clearance between the back of the angle and the face of the column increased from .004 in. before loading to .029 in. at 45,000 lb. When the load was reduced after 45,000 lb. had been applied, the permanent clearance was .017 in. At 49,500 lb. a crack developed in the welding at one corner of the angle at the top. As the load was increased the crack opened up gradually and at 76,500 lb., the weld was cracked on both sides of the angle at the top. At 116,000 lb., the weld tore down on the side which first showed signs of cracking, for a distance of about 1 in. The end of the beam dropped about 1 in. and the flange of the beam was permanently bent.

# Gypsum Blocks for House Construction

## Residences of This Type, Recently Erected in Montreal, Prove the Adaptability of Gypsum Materials—Comparisons of Costs with Brick is Favorable to Gypsum

By J. F. CAMERON, Ontario Gypsum Co., Ltd., Paris, Ont.

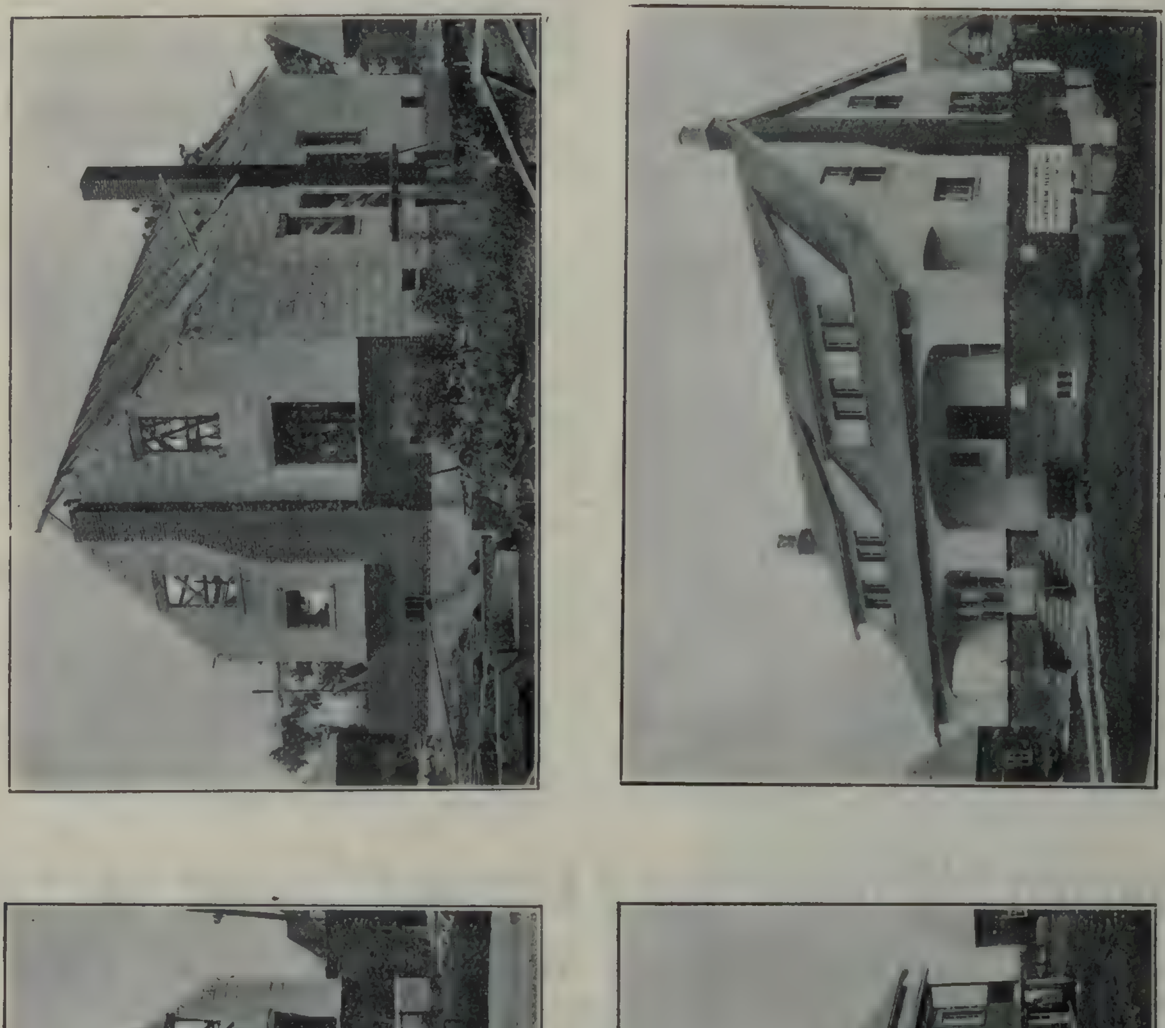
The first houses in Canada constructed of gypsum block were erected at Paris, Ontario, by the Ontario Gypsum Company, Limited, some three years ago. Before the erection of these houses was proceeded with, it was definitely established that the gypsum block were sufficiently strong in compression to carry the estimated load. These tests were carried out by the University of Toronto.

Last winter some fifty houses of gypsum block were erected in the city of Winnipeg, and a few others in various cities throughout the West The Ontario Gypsum Company, Ltd., however did not make any further effort to have more houses put up until they were absolutely sure of their ground and had given this type of construction the only test which is final, namely, the subjection of a dwelling to the weather. It might be interesting at this point to say that the east end walls of the houses erected at Paris, Ont., were left entirely uncovered and the gypsum block have been exposed to the weather for three years without any signs of deterioration.

This summer a prominent builder in the city of Montreal erected a double house using gypsum block for the exterior walls and gypsum block and hardwall plaster for the interior walls. This house, a cut of which we show herewith, is a beautiful building and is situated in one of the finest residential districts in Montreal. It was very quickly erected, and the contractor effected a considerable saving by using gypsum block. This house was erected according to the specifications of the Ontario Gypsum Company, this firm having a representative on the job most of the time to keep a very close check on the cost.

### Comparison of Costs

In the city of Montreal most exterior walls of brick houses are twelve inches thick. Using this for comparison, we find that a gypsum block wall constructed of 4 inch solid gypsum block on the inside, 2 inch air space and 3 inch gypsum block on the outside covered with Pulpstone hardwall plaster for first coat and Pozzo exterior stucco for second coat and Pozzo finish stucco for the third coat, reinforced with wire costs approximately $6.50 per yard, including block, labor, scaffolding, plastering material, plasterers' time and everything which went into the cost of construction. Against this we have the cost of a



Progress views of Montreal homes built of gypsum products

12 inch brick wall, which figured on the basis of $22.00 per M. for the brick and $20.00 per M. for labor gives us a cost of $8.51 per yard. To this must be added the cost of interior strapping and lathing estimated at approximately 50 cents per yard, which would bring the total cost of a 12 inch brick wall complete to $9.01 per yard. This item is saved in a gypsum house as a gypsum block wall does not have to be strapped and lathed on the inside as the plaster is applied directly on the face of the block.

In Western Ontario the general practice is to use 9 inch brick for the exterior walls of a house. We find on using the same cost for brick, namely, $22.00 per M. and $20.00 per M. for laying that the cost of a 9 inch brick wall would be $5.67 per yard plus 50 cents per yard for lathing and strapping, making a total of $6.17 per yard. This 9 inch brick wall, however, is figured only on common brick at $22.00 per M., and if a good face brick were used the cost would be greatly in excess of this. These figures are very illuminating and are authentic.

The money saving on the exterior walls is a very great consideration, especially at the present time when the cry is for "more moderately priced dwellings."

Naturally, the cost of the walls on the house erected in Montreal will cost more than an ordinary square plan house, due to the fact that there is a good deal of cutting and fitting to be done on a bungalow type.

### Interior Walls Made of Gypsum

The interior bearing walls, both in the basement and above the grade, were constructed of gypsum block. The dividing walls between the two houses were also constructed of gypsum block. This effects another large saving as the blocks are easily and rapidly erected, as they each have an area of 2½ sq. ft., and are ample in strength to carry the load. The cost of constructing the interior bearing partitions, which were made up of two 4 inch solid block back to back, was approximately $5.00 per square yard.

The interior partitions were gypsum board with hardwall plaster applied thereon. The cost was approximately 70 cents per yard, which included the board, time for putting it on, plaster, plasterers' time, etc.

The cost of the exterior Stucco, not including the gypsum block, was $1.70 per yard.

Gypsum block when stuccoed according to the specifications are absolutely waterproof and form a wall of great strength and durability. The Ontario Gypsum Company, Ltd., we understand, are prepared to give a ten years' guarantee on this type of construction.

Gypsum is a perfect insulator and a house constructed of this material would be more economically heated in the winter and would be cooler in the summer than if any other material were used.

Another very important consideration is the fact, that no insurance is needed on a building of this type. It is absolutely fireproof.

The Ontario Gypsum Company, Limited, are the pioneers in the construction of dwellings of this type, and it is their belief that in a very short time this method of construction will be generally adopted.

# Specifications for Street Railway Pavements and Track Construction

In connection with its report presented Oct. 27 at the 27th annual convention of the American Society for Municipal Improvements, the committee of which Charles E. De Leuw of Chicago is chairman, submitted specifications for street railway pavements and track construction. These specifications were not presented for adoption in their present form, but more for the purpose of providing the basis for a final draft. The specifications follow.

1. **Excavation.**—1. The contractor shall excavate the space to be occupied by tracks to a depth of—inches below finished grade. And soft, spongy or otherwise defective material shall be removed from the subgrade, and replaced with sound material.

2. The subgrade shall be thoroughly rolled with a three-wheel roller weighing not less than 10 tons where practicable. In places inaccessible to the roller compression will be secured by tamping.

2. **Subsoil Drainage.—3.** In all soils except sand, gravel or sandy loam, subsoil drainage shall be provided.

4. This shall be done by laying either 4 or 6-in. tile pipe in a trench surrounded by crushed stone, gravel or cinders. The drain shall be laid under the center of each track or midway between tracks, as may be determined by the character of soil.

5. Provision shall be made for connections leading from the base of the rails to the subsoil drains, at frequent intervals.

6. Subsoil drains shall be connected to the sewers by means of vitrified tile pipe, of a suitable size.

3. **Foundation.**—7-a. Plain Ballasted Construction. The ballast shall be evenly spread in the trench so that, after being thorougly compacted with a 3-wheel roller weighing not less than 10 tons, it shall have a minimum depth of—inches.

8-a. Ballast shall consist of clean, hard, durable crushed stone or gravel graded so as to pass a 2-in. screen and be retained on a ¼-in. screen.

7-b. Concrete Slab Sub-ballast Construction. Upon the subgrade prepared as above described, shall be laid a portland cement concrete slab—inches in depth. The concrete shall conform to the A. S. M. I. specifications for concrete for pavement foundations.

8-b. After the concrete slab has set a layer of ballast shall be laid to a maximum depth of 3 in. Ballast shall consist of clean, hard, durable crushed stone or gravel graded so as to pass a ⅝-in. screen and be retained on ¼-in. screen. Ballast shall be well compacted by tamping.

7-c. Solid Concrete Construction. Upon the subgrade prepared as above described shall be laid a concrete foundation which shall be constructed integral with the pavement base. The concrete work will follow immediately after the surfacing and lining of the track. The final concrete shall be brought to a height—inches below the top of the rail and shall coincide with the grade establised for top surface of pavement base. Concrete below and around ties and rails shall be thoroughly rammed and tamped. If the engineer deems it necessary, cement grout shall be poured so that all voids will be filled. Care shall be taken in tamping under and around the tie and rail so that the surface and line of the track shall not be disturbed. In no case shall the ends of ties be covered by a board while placing the concrete.

8-c The concrete shall conform to the A. S. M. I. specifications for concrete for pavement foundations.

**4. Rails.**—9. The rails used shall be of a type and weight which shall meet the approval of the engineer. The T-Rails shall comply with specifications of the American Society for Testing Materials. The High T-Rails and girder rails shall comply with specifications of the American Electric Railway Engineering Association.

**5. Rail Joints.**—10. Rail joints shall be modern bolted, riveted or welded joints. The joint selected shall produce the effect of a continuous rail. The type of joint and the method of making shall be approved by the engineer and be subject to his supervision.

**6. Rail Fastenings.**—11. The rail shall be brought to proper gauge and fixed securely to ties by track spikes or screw spikes. Clips shall be used in all cases when screw spikes are used. The type and dimensions of the rail fastenings shall be approved by the engineer.

**7. The Plates.**—12. Upon each tie and under each rail shall be placed a tie plate. The size, type and weight of the tie plates and the method of fastening to the ties shall meet with the approval of the engineer.

13. When tie rods are not used, suitable brace tie plates shall be placed as directed by the engineer.

**8. Ties.**—14. Wood ties (untreated). All ties shall be either No. 1 white oak or 90 per cent heart long-leaf yellow pine.

15. All ties must be square edged and sound and sawed out of straight-growing timber.

15-a. They shall conform to specified dimensions, be out of wind, with sawed ends, and straight and parallel faces. Ties shall be free from splits, shakes, loose or decayed knots, or other imperfections which may impair their strength or durability.

16. The standard dimensions of all ties shall be 6 in. in depth, 8 in. in width and 8 ft. in length. A variation from the standard dimensions of 1½ in. in depth and width and 1 in. in length will be permitted, provided that not more than 20 per cent of ties under the standard dimensions will be accepted.

17. Wood ties (treated). All ties shall be of long-leaf yellow pine, short-leaf yellow pine, loblolly pine, Norway pine, Oregon fir, cypress, white oak or red oak.

18. Ties shall conform to the specifications in paragraphs 15 and 16 as to quality and standard dimensions.

19. The air-seasoning of timber is preferred before steaming, but where sufficient time cannot be allowed for this, fresh cut timber will be allowed to be substituted for treatment.

20. The character of the antiseptic solution and the method used shall be subject to approval of the engineer.

21. The spacing of ties shall not be more than 24 in. center to center.

**9. Pavement Base.**—*22.* After the foundation has been constructed, the track laid and brought to proper alinement and grade, the pavement base shall be laid. It shall be of concrete which shall conform to the A. S. M. I. specifications for concrete for pavement foundations. Concrete shall be thoroughly rammed and tamped around ties and rails.

23. Care shall be taken in tamping around the tie and rail so that the surface and line of the track shall not be disturbed. If the engineer deems it necessary, cement grout shall be poured so that all voids shall be filled. In no case shall the ends of the ties be covered by a board while placing the concrete. Care must be taken to have the outside edges of the concrete conform to the dimensions. The concrete shall extend from the bottom of the ties to a grade above the tops of the ties—inches below the top of the rail.

**10. Rail Filler.**—*24.* The spaces under the heads of the rails and next to the webs shall be filled ahead of the pavement with portland cement mortar composed of 1 part portland cement and 3 parts torpedo sand. At the option of the engineer mastic may be substituted consisting of asphaltic concrete binder.

**11. Stone Block Pavement.**—*25.* The stone block pavement shall be laid with blocks at right angles to the rails. The pavement shall be laid ¼ in. below the grade of the rails. The quality, and size of the blocks, the mortar cushion, the method of laying and tamping shall conform in all respects to the specifications of the A. S. M. I. for stone block pavement. The filler used and the method of filling joints shall also conform to the said specifications.

*26.* Where a T-rail is used, the engineer may require a special nose block to be used which will butt against the web of the rail and under the head.

**12. Brick Pavement.**—*27.* The brick pavement shall be laid with blocks at right angles to the rails. The finished surface of the brick pavement shall be ¼-in. below the grade of rails.

The quality and size of the brick, the sand cushion, the method of laying and rolling shall conform in all respects to the specifications of the A. S. M. I. for brick pavements. The filler used, the method of filling the joints and expansion joints shall also conform to the said specifications.

**13. Wood Block Pavement.**—*28.* Along both sides of each rail two rows of stretchers shall be laid. The stretchers may be stone or brick as may be determined by the engineer. The stretchers shall conform to the above specifications in all respects. Additional lines of stretchers may be used at the option of the engineer.

*29.* The wood block pavement shall be laid with block at right angles to the rails. The finishing surface of the pavement shall be flush with the top of surface of the stretchers. The quality and size of the wood block, material with which they are impregnated, methods of treatment, methods of laying and rolling, filler, method of filling and expansion joints shall conform in all respects to the specifications of the A. S. M. I. for creosoted wood block pavement.

**14. Sheet Asphalt Pavement.**—*30.* Stretchers along rails shall be provided as specified in Paragraph 28. The sheet asphalt pavement shall be laid so that the top surface shall be flush with the top surface of the stretchers. The character of the sheet asphalt pavement, the mehod of laying and rolling shall conform in all respects to the specifications of the A. S. M. I. for sheet asphalt pavements.

**15. Portland Cement Concrete Pavement.**—31. Concrete shall be laid so that the finished surface of the pavement is ¼ in. below the grade of the rails. The character of the material, method of mixing and laying, reinforcement, method of finish and protection shall conform in all respects to the specifications of the A. S. M. I. for cement concrete pavements.

# Heating and Ventilation of Factories

## A General Outline of the Principles Involved and the Methods Adopted to Maintain Satisfactory Working Temperatures and Atmospheric Conditions

By H. H. ANGUS. Consulting Engineer, Toronto, before the Toronto Branch of the American Society of Mechanical Engineers

In order to get a correct view of this subject, it is abvisable to start at the heat losses from buildings and then describe the method of taking care of these and later the ventilation requirements for various buildings.

The first item to consider is the heat losses. These losses depend on the size, shape and location of the building, also its use and construction. The old rule-of-thumb methods are not sufficiently reliable for use on buildings of any size and may only be used as checks. We must first decide the temperature to be maintained inside the building, which for general factory work, is usually about 60 deg., but this depends on the nature of the worker. Such work as type setting requires a temperature of 70 deg., which is also the casein factories where the worw is very light and the operators are seated at benches, such as in jewelery manufacturing. In one factory different processes often require different temperatures.

The outside temperature and the velocity and direction of the prevailing winds may be secured from the observatory records. While the heating system must be sufficient to care for the coldest weather, it is not advisable to use the minimum temperature in making calculations. The low temperatures do not usually last more than a day or so and it requires two or three days for the average factory building to get cooled down inside. If the minimum average for three days is used, it will be found that the heating system is sufficient. For example, in Toronto we have had temperatures as low as 26 deg. F. below zero, but this low temperature does not last usually more than a day. The average low temperature for a period of three days is not usually much below zero so that in this vicinity a heating system is usually designed for an outside temperature of zero or 5 deg. below. This is usually ample if the building is kept warm all the time.

Knowing now the inside and outside temperatures, we can get the difference between them. In Toronto and vicinity this would be probably 60 deg. F. for shop sections and 70 deg. F. for office sections. It is interesting to note that this changes within a comparatively short distance from the city.

### Determination of Losses

The losses of heat in B. T. U. per square foot per degree difference for various materials used in construction has been gone into fairly well by a number of authorities who have made actual tests on sample walls, roof, etc. There is some considerable difference in the factors for the same construction due to a great extent to the fact that no sample walls are built in exactly the same way. New tests are constantly being made, however, so that agreement on certain constants will, no doubt, soon be reached. Tests made cover a great variety of construction of walls, roofs, windows, etc.

Having now the difference in temperatures inside and outside, and the heat losses per square foot, we are able to figure out the heat losses for the building except that due to air infiltration. For example, the constant for single glass windows with good sash is 1 and if we have a factory in Toronto with 1,000 square feet of exposed glass, the loss through the glass will be 60 x constant 1 x area 1,000 or 60,000 B.t. u. per hour In a similar way the losses through roof, floors, walls, etc., are calculated and we get the total loss from the building except that due to air leakage. The losses should be multiplied by a factor dependent on exposure. For north walls, for instance, it is usual to add 25 per cent. and less for other exposures, but these factors depend to a great extent on the location of the building in relation to others.

### Air Leakage

Now to get at the loss due to air leakage, we have several factors to consider. If the building covers a considerable area an dis good construction, it is sufficient to allow for a half of one complete air change per hour. This means that one half of the air contents of the building must be replaced by heated air every half hour. This air change varies from ½ to 1 and soemetimes more than that for narrow buildings with great exposure. This change, of course, depends on the wind velocity as well as other factors, but it is unusual in most places to have a strong wind during extreme cold weather. Another method used to figure air losses is to assume that all air comes in through cracks around the windows. Knowing the construction of the windows and building, we assume various widths of cracks around the windows and by multiplying these by the perimeter of the windows and the velocity of the air, we arrive at an air change. As both methods depend to a great extent on experience and judgment, there is little to chose between them. The losses due to the air change are the only losses which cannot be calculated accurately, although experiments are now under way to determine these by experimenting with rooms of different construction. Having decided the air leakage per hour and knowing the specific heat of air, we can easily calculate the heat loss due to air infiltration.

By totaling all losses, we now know the total loss of heat from the building which must be replaced by the heating system. It is probable that as the cost of coal advances, more attention will be given to the best construction for heat insulation.

We now have the heat losses from the building and the question is how to replace them. If the factory has a large number of motors, or other sources of power, we can take the heat developed from these from our heat losses, as the power turns to heat energy We have also the heat given off by human beings. This amounts to about 400 B. t. u. per hour per person and the effect is very noticeable in such buildings as theatres, which require no heat after the audience arrives. These sources of heat are usually negligible for factories, although in textile factories they are well worth figuring. There may be other sources of heat depending on the work being carried on. Unless the process is continuous, however these sources of heat should not reduce the size of the heating apparatus as the average factory is closed from noon Saturday till Monday morning. They will, however, reduce the demand on the heating apparatus during working hours and reduce the coal required per year.

### Methods of Heating

It would be possible to provide the necessary heat by means of stoves located in various parts of the factory, but under present day conditions of manufacturing, it is advisable to concentrate the heating sources in one location. If we place our heat source in a location convenient for handling coal and ashes, we must use some medium for carrying the heat from this source to the varied parts of the building where heat is required. The mediums at present in use are air, water and steam, although there are many other substances which could be used and may be used in the future.

The next question is how to get the water, steam or air which we use, to carry the heat from the boiler or source to the place where it is required. All these substances expand when heated and, therefore, weigh less per cubic foot when heated than when cold. This forms the basis on which the gravity systems of heating operate. If the heat is to be carried short distances the gravity systems give good service, but for larger buildings it is necessary to force the movement by mechanical means, so we have the blower system of hot air heating, the forced hot water system and, in case of steam, the vacuum system which pulls on the system instead of pushing, in order to get rid of air which is difficult to handle in steam systems.

We now come to the practical application of the problem. Gravity hot water and gravity air systems are limited to smaller factories, so that for medium and large factories we have the following: First, the blower system; second, steam heating either gravity or vacuum, and, third, forced hot water. It is possible to heat a factory by any of these systems, but each has advantages and disadvantages which make it more suitable for certain classes of buildings. We will consider them in order.

### Blower System

First the blower system. This system is particularly adaptable to large open buildings such as boiler shops and foundries and also to buildings where ventilation is a prime factor. In open high buildings, if a steam or water system is used, the heat tends to concentrate at the roof, even with the radiators at the floor, so that the temperature at the roof of a high building may be 25 or more degrees hotter than at the place where the men are working. This results in high roof losses. For this work a blower system may be placed at the ground level or in the roof trusses and by means of ducts the heated air is carriied to a point within a few feet of the ground where it is blown towards the ground and therefore carries the heat where needed. Fans for buildings of this kind are usually fitted with means for recirculating the air so that the fan may draw part of its air from inside of the building and part from outside and the proportions may be adjusted from time to time to suit the requirements of ventilation and heat. This system seems ideal for buildings where a large amount of ventilation is required. The air is usually heated to about 125 deg. F. in the coldest weather. It may be heated by means of steam coils supplied with steam from a boiler plant or by means of a hot air heater, although the latter seems difficult to make. The blower system has also been used to heat factory buildings with storeys not over 12 ft., but in this case the ducts usually take up a lot of room. To overcome this, the ducts have sometimes been run on the roof or under the basement and the air carried down through hollow columns. Hot air systems of this kind give good ventilation but are expensive to operate unless most of the air is used over again.

### Steam and Hot Water Heating

For the ordinary factory, consisting of a building several storeys high of 12 to 20 ft. each, radiators either of cast iron or pipe coils are usually placed around the outside walls under the windows and supplied with steam or water. There are various methods of piping these systems. The best is the overhead supply system where the steam or water supply main is carried to the ceiling of the top floor and runs around this and the risers pass down through the building and feed the radiators at the top while return risers are connected to the opposite end of the radiators and are run to the basement and connected to a return main running around the basement ceiling or floor. With this system the steam pipes are easily cleared of condensation so the radiators are supplied with fairly dry steam. The same system may be modified by carrying the steam main around the basement ceiling in place of the attic and in this case the steam flows upward in the risers instead of downwards. For steam systems a single main may be run in the basement and a single riser to each row of radiators. In this case both steam and condensation flow in opposite directions in the same riser, so that this must be bigger. For hot water systems the nearest to this is the one pipe circuit main in the basement with risers and returns run to radiators on the shunt system or the attic supply and basement return and the one pipe riser.

### Removal of Air in Steam Systems

These are the main systems although there are many modifications. In steam systems one of the main difficulties is to get a proper system for removing the air which is heavier than steam. For this purpose, on cheaper systems, air vents operating on the expansion principle are used and the air let out into the room; on better systems the outlets from the air vents are connected together and a pump or other suction device placed in the boiler room which draws the air to the basement where it is gotten rid of by an air eliminator. For better systems still it is advisable to install a thermostatic trap on the return end of each radiator. This passes both condensation and air but closes when steam strikes it.

The returns are usually connected to a pump in the basement which draws back the condensation and air from the system and after getting rid of the air, forces the condensation back into the boiler. For smaller buildings, this system will work without a pump, unless the radiators are placed in peculiar positions.

In order to bring the cost of installation of a hot water system to about the same level as a good grade steam system, it is usual to place a safety valve on the expansion tank, set at 10 to 15 lbs. This will allow the water to be carried up to about 225 deg. F. without boiling. A pump with 25 or 30 foot head is also used and this allows the use of very small pipe on an ordinary size building. Under these conditions, the size of radiators will be the same as for steam system and the pipe sizes approximately the same although they may be made considerably smaller.

The boiler plant is practically the same size no matter what system of heating is used. We know how much heat is required to be put into the building and if we add 15 to 20 per cent. to this for supply and return pipes, which are often placed where most of their heat is wasted, we get the amount of heat which must be put into the building.

### Types of Boilers

There are many types of boilers in use at present. If the factory has no use for exhaust or live steam, it is usual to use low pressure boilers suitable for about 15 lbs. pressure. The cheapest boiler is the sectional cast iron boiler. It is less efficient than a steel boiler and will not stand misuse, but if used carefully, it will no doubt, outlast any steel boiler, as it is much thicker. Of the steel boilers there is the standard horizontal return tubular boiler which has been used extensively. If these boilers are set with the boiler well up above the grates, they will give good satisfaction. Unfortunately, however, it is hard to get bricklayers to make a good job on boiler setting, with the result that in a year or so air leaks in around the fire and spoils the combustion. For this reason steel firebox boilers of the locomotive type have come into use during the last few years and these have internal firebox and are also made to be put up without brick setting so that the danger of a poor brick setting is eliminated. There is a new boiler of the water tube type now being put on the market which should give good results. It is really the high pressure water tube boiler adapted to small low pressure work. There are also many makes of patented boilers with many unusual features. The average efficiency of heating boilers is about 60 per cent. and there is not so very much difference between the efficiency of cast iron and steel boilers except in the larger sizes.

On good sized plants it is advisable to use at least two boilers, and each of these are designed to carry about 60 per cent. of the total load so that in severe weather it can be forced to carry almost the full load. It is not usual to use mechanical stokers on heating plants except for very large buildings.

Generally speaking, all equipment in connection with low pressure heating systems must be made as simple as possible as these systems are usually operated by firemen who are poorly paid and have no idea of caring for good apparatus. Even the simplest type of a pump or trap is liable to get out of order and necessitate repairs. It is for this reason that in general, down draft boilers with double grates for burning soft coal without smoke have not proved so efficient in use as they appear on test. The firemen change so frequently that it is very difficult to get the fireman to fire these boilers in a correct manner.

While the design of the low pressure heating system is very simple there are a great many put in without any regard to economy of operation and many put in neglecting some of the fundamental principles.

### Central Heating Plants

Where we have buildings in groups to be heated, the best method is to install a central heating plant and carry lines from this through tunnels to each of the buildings and pipe each building as if it had a heating system of its own, except that the boilers, pumps, etc. are omitted. For large factories the boilers should be of the best grade, and automatic stokers used with coal, and ash handling systems. In these large systems it is usual to use high pressure boilers and generate electric power, using the exhaust steam from the engines for the heating system. When a hot water system is used the exhaust steam is used to heat the water in a heater filled with brass tubes, through which the water is pumped, while around them the exhaust steam circulates. This condenses the steam and at the same time in the season creates a slight vacuum. There is usually an auxiliary live steam eater installed to take care of breakdowns and to be used when there is not a sufficient supply of exhaust steam. The water is circulated by means of centrifugal pumps driven usually by steam turbines. On large systems the friction head is often as high as 100 feet and while this requires fairly large driving units, it saves in size of piping required and as long as the exhaust steam can be used, the reduction in pipe sizes is obtained at comparatively small cost. There are several advantages of water over steam for spread out buildings, one being that the water main may follow the contour of the ground and no drips are necessary. Another advantage is that the temperature of the water may be adjusted to suit the outside temperature so that no valves need be touched, while a steam system must give almost constant temperature to the radiators and therefore these must be opened or closed a number of times each day or the building becomes overheated. Where a number of buildings are to be heated from the same main and they are situated at various distances from the power house, a differential pressure valve is used and set so that the pressure between the supply and return to any one building will remain practically constant regardless of changes in the pressure in the mains.

### Ventilation

In large open factories where employees are not placed close together and there are plenty of windows, mechanical ventilation is unnecessary unless there are tumes such as in a foundry. In other buildings, however, where large numbers of employees are working in a limited space, mechanical ventilation is advisable.

The ventilation may be accomplished by the heating system by the use of a forced blast system in which a certain amount of fresh air is drawn in from outside and the inside air exhausted through roof ventilation.

It may be also accomplished independent of the heating system. In this case the heating system is designed to take care of the heat losses through the walls, floors, etc., and the ventilation is accomplished by fans which draw fresh air from outside and pass it over to the heated coils and discharge it into the factory at a temperature of 65 deg. F. or so. The foul air may be drawn out by means of a fan or may be passed out through ventilators due to gravity and the slight pressure put on the room by a fan. For simple systems, exhaust fans only are used and they draw in fresh air from openings around the windows and doors.

In factories making textiles and other special lines it is very necessary to use high grade ventilation systems which are arranged to give good ventilation and also keep the temperature and humidity of the air at certain points which are known to give the best results. Such conditions are necessary to give uniformity of product. These systems have greatly increased in number during recent years and it is evident that they result in much better quality and quantity of product. They should keep a room at, say, 65 per cent. relative humidity and 60 deg. F. regardless of the conditions outside. This is accomplished by means of a fan, heating and cooling coils and an air washer. The air drawn from outside is heated to, say, 42 deg. F. by being passed through coils which have automatic control. It then passes through a series of fine water sprays which clean it and after these it hits baffle plates which remove the surplus moisture and it is then passed through other heating coils which heat it to a predetermined temperature, after which it enters the fan and is blown through ducts into the room to be cooled. It is evident that as the air passes through the washer it becomes saturated with moisture. If the temperature of the spray chamber is 42 deg. F., for example, the air is saturated at 42 deg. F. if the washer is 100 per cent. efficient and when it passes out of the washer it goes to the coils where it is heated to say 80 deg. F. and being unable to obtain further moisture, it is probably only 75 per cent. saturated and, therefore, the relative humidity is 75 per cent. It is evident that by rising the temperature of the spray water, the air may be saturated at any temperature we desire and, therefore, the relative humidity on entering the room may be arranged to suit. Where it is desired to reduce the humidity of the air, the spray water is cooled by refrigeration so that when the outside air strikes the cooled spray it is cooled and deposits some of its moisture in the washer.

### Cooling Devices

Cooling devices are used, for example, in the summer in factories making chocolate which is best worked at about 60 deg. F. the year around and 50 to 60 per cent. relative humidity. Automatic devices are now in use for regulating the humidity and temperature. Of course, when the treated air coming into the room mixes with the air already in the room its condition will be altered somewhat and this must be taken into consideration when setting the apparatus. Where special systems of this kind are installed, it is usual to recirculate a great part of the air and only bring in such quantities of outside air as are advisable, depending on the outside conditions.

A recent example of this apparatus outside of ordinary ventilation of air washers is in the dry air system for blast furnaces in steel mills. The outside air in this case is cooled down till it deposits the greater part of its moisture and is then blown into the stoves to be heated. The saving, of course, is due to the fact that under ordinary conditions a large amount of heat is used to heat the water vapor and this is all wasted. Mr. Gayley, the inventor, or first user of this system, gives figures showing a large increase in production of iron at a considerable saving in fuel.

# Keeping Costs of Highway Operations

## A System Developed for Providing Accurate Figures on Road Construction and Maintenance—While This Scheme Was Used in the Old Country It Has a General Interest

By J. C. HALLER, County Surveyor, Nottinghamshire, Eng., before County Councils' Association, Association of Municipal Corporations, and Urban and Rural District Councils' Association.

From the first days of the formation of highway authorities there has been the necessity for a system of costing in connection with the work carried out by the highways department, but with the exception of some of the large boroughs and counties there has not been, nor is there at the present time, any real attempt at putting this branch of the department on a proper and systematised footing. This lack of system in keeping account of the work carried out by highway engineers cannot altogether be laid at the door of the official concerned. In the majority of cases of urban and rural councils, if sufficient account is kept showing the cost of the main roads, apart from the district or other roads, to succeed in obtaining a payment from the county authority, the council concerned do not see the necessity of paying for the additional staff which would be necessary to keep proper accounts, although it would undoubtedly mean a saving of ratepayers' money in the detection and stopping of leakages, of which there are so many to a greater or lesser degree in all public departments, according to the keenness of the official in charge.

There are hundreds of urban and rural districts and small boroughs where the staff of the engineer and surveyor consists of a junior assistant or an office boy, and in such cases it is an impossibility for that official even to attempt to keep accounts in any but the most elementary form. In putting forward for your consideration the system outlined in this paper, I am quite aware that it is too elaborate to be dealt with by a small staff such as mentioned, but there is no reason why such portions of the system as may be applicable should not be adopted for small authorities. If a uniform system were adopted, one account clerk should be able to do all the clerical work necessary for the ordinary urban or rural district, and his salary would be much more than saved by the economies effected.

### Need for Business Methods

There is, however, one feature of this matter to which engineers and surveyors should give consideration, and that is, that in the training of pupils who ultimately become engineers and surveyors, no business education seems to be thought necessary. How many young engineers have taken up chief appointments, and whilst they are sound and competent engineers and have all the theoretical, and some practical, knowledge of engineering, have not the least idea of business methods or the value of money. When it is borne in mind that on highways there is a tremendous amount expended per annum it is surely necessary that this money should be expended not only in the best possible manner from an engineering point of view, but also from a commercial or business point of view.

Quite recently the complaint has been made by certain organizations which are called upon to pay large amounts by way of taxation on mechanically propelled vehicles, that full value is not obtained for the money expended on highway construction and maintenance, and that better results would be obtained if the work were carried out by contractors. This complaint is from men who have to expend their money and carry on their business with a view to presenting a satisfactory balance sheet, and whilst I am not prepared for one moment to accept the statement that better results would be obtained if highway maintenance were carried out by contractors—with which statement I entirely and emphatically disagree—I am bound to say that there is some cause for the complaint, and local authorities and their engineers must adopt more of the business man's methods and show more keenness in obtaining full value for the money they expend. One step in this direction would be that highway authorities should have one form of accounts, and I venture to suggest here that county engineers should also adopt a common form for their annual reports. These reports, I believe, at the present time give much valuable and interesting information, but how much more valuable and interesting would they be if they were put on a uniform and comparable basis.

A proper and complete system of accounts in connection with the construction and maintenance of highways is now essential if the data required by the government is to be correctly supplied. To supply this information the accounts of a highway authority must show the details of expenditure on labour, materials, haulage, rolling, use of tools and plant and sundries, not only on classified roads and other roads, but on each road separately, and under separate heads of ordinary maintenance and special maintenance. Generally speaking, ordinary maintenance includes all ordinary small patching work, tar-spraying, draining, etc. Not only, therefore, is the cost of each road necessary, but of each section of road resurfaced or coated.

In putting before you the system of accounts in use in my own department, it must be borne in mind that the authority is a county council, and the system does not cover a range of depots such as are in use in large boroughs. I appreciate that there are many things which may be criticised and may be improved.

The most convenient form in which to deal with the subject of this paper will be to take each head separately, and I therefore propose to take the various items in the following order: (1) Administration, (2) division of roads, (3) materials, (4) haulage and team labour, (5) mechanical haulage, (6) rolling, (7) record of work done, (8) manual labour, (9) plant and tools, (10) financial statements, (11) road reinstatements.

### Administration

The whole of the clerical work and book-keeping is done by the staff at the head office. Divisional surveyors are not required to keep any accounts, except to supply such information to the head office as is required, and this system is explained in detail later. The whole of this branch of the work of the department is in this manner controlled at one office, and full information as to the financial position is available at a moment's notice, which is not only desirable but necessary if there is to be complete control by the responsible official.

### Division of Roads

The whole of the roads maintained by the county council are divided into divisions of one mile in length, each division being numbered.

### Materials

The estimates prepared at the commencement of the year show the amount of material of various kinds and gauges allocated to each division for the year, and tenders are obtained from the various firms supplying the class of material required for delivery to railway stations where it will be required.

Upon it being decided that a certain road is to be dealt with, the divisional surveyor concerned forwards to the office a requisition for a certain quantity of material, stating the number of tons required to each division. An order, is then forwarded to the firm supplying the material on a form which gives the class of material required, the rate of delivery, the railway station, the carter's name and address, the name and address of the divisional surveyor, and on the carbon copy of the order is shown the price per ton and the total estimated cost of the whole of the order; each carbon copy also shows the total cost of the material ordered from the commencement of the year up to the date of that order, so that at a glance the cost of all material ordered up to date can be seen, and over-expenditure of estimates is thus avoided; at the same time a postcard is sent to the divisional surveyor informing him that the order has been given, so that he may give notice to the haulage contractor to prepare for delivery.

Every firm supplying material is required to send an advice note to the head office and to the divisional engineer, also an advice on a special form to the carter on which the carter is required to give the date of the arrival of the material at the station and date of unloading. This form is duly certified by the divisional engineer stating that material of specified weights has been delivered on to a road in a certain division. These weights are entered in a materials book at the office, having a separate page for each division of road, showing the name of the firm supplying the material and the carter so that payment is made on the same tonnage to both contractors. In the case of materials being unloaded by the county council steam wagons, the driver is required to fill in on the weight check the particulars, and these are certified by the divisional engineer.

### Haulage and Team Labour

Forms of tender, showing every division of road in the county with the railway station at which the material for each division will be delivered, are sent out to the various haulage contractors and carters in the county, who tender at piecework rates for the delivery of the material from the station on to the road, and to day-work rates for such other work as re-carting materials from depots, machine sweeping picking up sidings and sweepings, or hauling water-cart for use with roller. The system with which the haulage contractors have to comply when hauling material has already been described under the heading of "Materials," but it may be added here that all contractors for the haulage of material are held responsible for the payment of any demurrage incurred at railway stations.

The divisional engineer in each division is responsible for the ordering and proper accounting of all team labour engaged on day-work. In cases where team labour is required as a matter of urgency, the length foreman for the particular area is empowered to issue an order ticket to the carter for that division to supply the horses and carts required. The length foreman has to forward weekly on a special card to the divisional engineer a return of the carts employed on his length, giving the date, name of carter, name of road, number of the division, number of days each cart has been employed, and the class of work that has been carried out. The divisional engineer is then required to send in a weekly schedule to head office, showing this information with reference to the whole of the day-work carting done in his area. These schedules are entered into a book which contains a separate page for each carter employed throughout the county, so that at any time the amount of work done by any carter can be checked and his account duly certified.

The accounts for haulage and team labour are rendered by the contractors on forms supplied by the department. These account forms are in different colours for each class of work—viz., piecework, re-carting, carting of sidings, sweepings, &c., and haulage of water-cart for roller purposes, thus obviating any possibility of accounts for one class of work being mixed up with any other.

When the account is passed forward for payment the whole of the particulars are entered into a team labour book, where the various items are dissected under separate headings for each class of work carried out.

### Mechanical Haulage

Where material is hauled from a railway station on to the road by means of the county council's own steam wagons, weight checks, as already mentioned under the heading of "Materials", are sent to the driver in charge of the wagon. In addition to filling up the particulars on this weight check, he is required to send a daily return sheet direct to the head office showing the number of journeys made, the time occupied in loading, travelling and unloading for each journey, the material carted, the station, the point of delivery, the number of the railway wagon from which the material has been taken, and the weight of each truck of material unloaded (this being obtained by the driver from the weight checks sent to him by the firm supplying the material). On this daily return sheet the driver is able to make application for oil, waste, fuel, and other materials required for the working of the wagon.

This daily return is completed in the office by the calculation of the number of miles travelled that day being added to the other particulars already supplied by the driver, so that each week a complete record of the work of every wagon is available.

A separate account is kept of the cost of everything in connection with the working of the steam wagons, so that at the end of each quarter the exact cost per ton per mile for material hauled by each wagon can be ascertained, and the proper proportion charged to each road for work done by the steam wagons in the haulage of material.

### Rolling

A separate account is also kept of the cost of all repairs, fuel, petrol, drivers' wages, &c., in connection with the county council rollers. A weekly return is forwarded to head office by the divisional engineer for each roller working in his area, showing the details for each day of work done, and the particular road and division of that road where the work is being carried out; these are summarised by the staff at head office into a roller record book, from which can be obtained a statement as to the exact number of days or hours that a roller has been engaged on each road in the county. From this the cost of rolling on any particular road or job can be ascertained.

### Record of Work Done

Accurate details of coating work, kerbs and drains actually carried out are kept by the following means: A tracing of each road is made from the 25-in. ordnance maps showing each division of the road, and in conjunction with each map is a loose-leaf register or chart with a separate page for each mile of road. These charts, which are on squared paper, are first divided into quarter miles and then into squares; each square represents 10 yds. longitudinally and 1 yd. in width. There are on each page 176 square longitudinally, and any number of squares can be adapted to fit the width of the road being dealt with. These charts are drawn up so that they can be used for a period of four years, and the information shown thereon is the quantity of the particular class of material and the date on which it was applied to the road, the exact area of the section of road being colored on the squared portion of the chart with a different colour for each kind of material.

A column at the side is provided for remarks such as the reason for a particular section of road being coated—for instance, extraordinary traffic or any other special damage. These charts are compiled from records supplied to the office each week by the divisional engineer, for the purpose of which they have printed forms (in duplicate), on which the information already described is given.

### Manual Labour

Manual labour wages are paid by cheque to each road-man fortnightly, a time-sheet being forwarded to the head office for each fortnight's work, showing on each day the road, the division, and the number of hours worked on the various kinds of work—for example, coating, patching, siding, draining, tar-spraying. Each divisional engineer's area is divided into two parts, which are paid alternate weeks. The time-sheets are collected by the divisional engineer on Wednesday of each week, and are forwarded, certified by him, to the head office. The wages sheets are then entered into manual labour books, which show the total amount paid to each workman for his fortnight's work, the total amount being divided under a heading for each road, and again subdivided under the various kinds of work already referred to, so that at any period the labour books show the amount spent on any class of work on each road, from which can be extracted the cost of any particular work of surfacing.

The wages cheques are despatched by post on Friday, being received by the roadmen on Saturday.

### Plant and Tools

Separate accounts are kept showing the working cost of such heavy plant as crushing machines, and this cost is apportioned to the various roads on the basis of the amount of material supplied from the plant to each job.

As regards the expenditure on tools, such as shovels, brushes, &c., in dealing with a large area such as a county, it is scarcely possible to charge definitely such items to a particular road, as it would not be economical to allot particular tools for work on particular roads. A more equitable basis upon which to allocate such charges is to keep a separate record of the total cost under this heading, and to apportion such amounts to the various roads according to the amount of work carried out, or, as regards ordinary maintenance, in proportion to the mileage of the roads.

### Financial Statements

With a view to keeping a definite check upon the amount of expenditure under the various headings, in addition to the necessity now of supplying detailed information to the government, it is important that a quarterly financial statement be prepared upon the lines of the engineer's original detailed estimate for the year.

In the county of Notts the estimate for the year is prepared and presented to the committee, showing the amounts required for each class of work—i. e., materials, manual labour, haulage, &c., and each quarter a statement is prepared showing the amount expended under each of these headings and the balance available. By this means one is able to ascertain whether the expenditure on work carried out during a given period is within the amounts provided for in the estimates, and at the end of the year the annual report presented to the county council gives the following information in respect of each road in the county—viz., number of road, name, mileage, average width, cost of manual labour, tons of material used, cost of materials, cost of tar-spraying, team labour, rolling, tools, sundries, establishment charges, drains and culverts, total cost of road, and average cost per mile. The expenditure is also now to be shown as divided between special maintenance and ordinary maintenance.

### Road Reinstatements

The item is one quite apart from the ordinary maintenance charges, but it is a very important one, particularly in populous areas where the roads are continually being interfered with by authorities, other than the highway authority, for such purposes as laying mains and services for gas, water, electricity, &c., and in my county a definite practice has been adopted that all persons, other than those acting under statutory powers, who interfere with the surface of the main roads, are required to obtain the consent of the highway authority before opening the road, and to deposit a small nominal sum towards the cost of finally reinstating the road surface.

Conditions are laid down by the county council as to the procedure to be followed with regard to the laying of mains under the highway, and as regards the filling up of the roads after opening. The final reinstatement of the surface is carried out by the county council's staff, and the person opening the road is charged the cost of such reinstatement, the necessary particulars as to area, &c., being supplied to the office by the divisional engineer concerned.

The county council also carry out the final reinstatement of all road openings made by companies or authorities acting under statutory powers who are charged with the cost of such work. Such an arrangement is very necessary, otherwise it is found to be very difficult to compel private individuals to restore the road surface to anything approaching its condition prior to the road being interfered with, and this will be well appreciated when it is pointed out that only recently a track was opened on a main road in a populous area, which necessitated a reinstatement at a cost to the contractors of over £300.

In considering the system of costing of highways it must be borne in mind that not only is it necessary to keep a record of such detailed information that it will be possible to supply to the government all the details required by that department, in order to secure the grant according to the classification of each road; but from the point of view of the engineer himself he must be able to ascertain from time to time not only the cost of construction with the various kinds of materials (many of which are now somewhat experimental), but the cost of the upkeep of each length of road for a period of several years, so that the merits and economic value of each kind of material when used under different conditions as regards the amount of traffic, &c., may be obtainable. At the same time it must not be overlooked that the best costing system in the world will not prevent pot-holes in roads nor keep roads in good condition, and it is therefore necessary that a sufficient and efficient staff should be kept for the purpose of keeping the necessary costing system, and so avoid encroachments being made on the time of the chief official and his divisional engineers, which could to greater advantage be spent in organising and supervising the carrying out of the various works under their charge.

## British Industries Fair Attracting Buyers

The eighth British Industries Fair which embraces a large number of the most important lines of British trade, will be held in London and Birmingham from February 27 to March 10. This is purely a trade fair where buyers and sellers meet, not an exhibition. This Fair, whether regarded from the point of view of size, diversity of products shown or resultant business, now surpasses in importance and value to the world's markets any other trade fair or similar purpose. A visit to the Fair will convince overseas buyers that enormous strides have been made in Britain's post war production. A considerable number of Canadian buyers are making arrangements to attend. Admittance is restricted to trade buyers on invitation of the British Government and business is not impeded by crowds of sightseers.

The British Trade Commissioners in Canada will be pleased to give full particulars and to issue invitation cards to Canadian buyers who propose to visit the Fair at their following addresses:— 248 St. James Street, Montreal; 260 Confederation Life Building, Toronto; 610 Electric Railway Chambers, Winnipeg.

## 11-Story Office Building for Toronto

A commencement was made last week on the eleven-story office building for the General Accident Assurance Company of Canada, at the corner of Bay and Temperance Streets, Toronto. The structure which is one of the largest under construction in the city at the present time, will occupy a lot 88 ft. x 66 ft. Mr. F. S. Baker, of Toronto, is the architect and the W. M. Sutherland Co. Ltd., are the contractors.

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A $2,000,000 bond issue to finance the construction of roads in British Columbia, was sold recently by the government to a large Toronto financial syndicate.

# How Should Peak Demands in a Water Works System be Met?

## Is a Reservoir Advisable or Should the Pumpage Capacity of the Plant be Increased?—A Study of the Question Based on the Experience of Cleveland

By L. A. QUAYLE, before the American Water Works Association

In the planning of a new waterworks project of comparatively large size, or the enlarging of one that is in service, it is necessary to determine how much of the hourly, daily, or monthly peak demands shall be taken by one or more equalizing or distributing reservoirs and how much by pumping engines in addition to those required to supply the average quantity of water consumed over a given period. It is assumed that the topography of the area to be supplied is such that reservoir sites are available.

In villages or cities of comparatively small size the capacities of stand pipes or reservoirs are largely determined by the fire protection requirements, rather than the considerations discussed herein. As the size of the city increases the relative capacity of the reservoir required for fiire protection becomes less and less, until in a large city the quantity of water used for a large fire is such a small part of the total daily consumption, that it has no appreciable effect on the hourly rate of pumpage or the daily quantity pumped.

In this discussion we are referring only to the equalizing or distributing types of reservoirs, the equalizing reservoir being one that is connected to the pumping station through the distribution system, and the distributing reservoir being one which receives all the water from the pumping station before it flows by gravity into the distribution system. Impounding or storage reservoirs, except where they are elevated sufficiently above a city to supply the water by gravity do not act as equalizing reservoirs for the distribution system and are therefore not of interest in so far as this particular problem is concerned. We are assuming throughout this discussion that the equalizing or distributing reservoir is elevated sufficiently above the highest buildings being supplied and that the distribution mains are of sufficient size to allow the water level in the reservoir to fluctuate over a wide range without appreciably affecting the distribution pressure.

While no two cities have exactly the same ratio of hourly, daily and monthly demands to meet, or have just the same ratio of intake, pumping station and filter plant cost, to reservoir cost, that hold good for Cleveland, we believe that our conditions are sufficiently representative of those which obtain in a large number of cities, that the analysis we have made of additional pumpage capacity versus reservoir capacity will be useful as a guide in the design of waterworks systems when the particular local conditions of the waterworks being planned are given due consideration.

In order to determine for what variation in demand for water a reservoir should be planned, we have studied the department's pumpage and water consumption records back to the year of 1910, and we have assumed that the maximum variation in demand a reservoir will be required to meet, corresponds to the maximum variation found on the maximum day, week, or month of the maximum year during the ten year period.

In order to simplify the computations, we have based our pumpage demand and cost curves on an average yearly water consumption of 100,000,000 gallons per day which is referred to as 100 per cent capacity on the various curves.

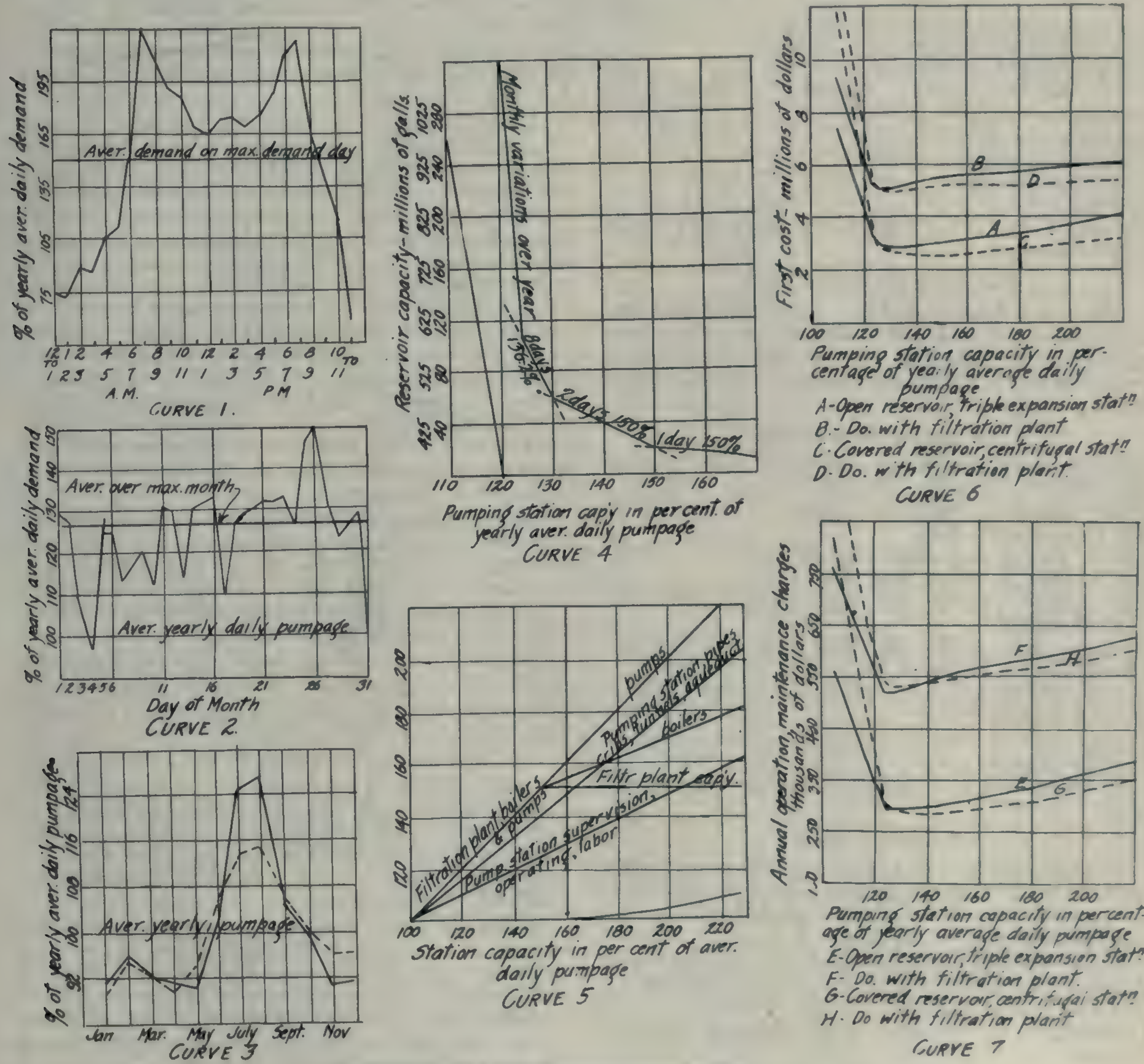
Curve 1 shows graphically the hourly variations in demand on a maximum demand day. The quantity of water pumped on a maximum demand day would be 150,000,000 gallons, and the rate of demand for the period of an hour would vary from 220,000,000 gallons per day from 7:00 to 8:00 a.m. to 60,000,000 gallons per day from 11:00 p.m. to midnight. The maximum momentary rate of pumpage would be approximately 225,000,000 gallons per day for a few minutes between 7:00 and 8:00 a.m. If a pumping station furnished water at a uniform rate of 150,000,000 gallons per day, a reservoir of 20,600,000 gallons capacity would take care of all the hourly and momentary fluctuations shown on the curve. If no reservoir were used a pumpage capacity of 225,000,000 gallons per day would be required.

Curve 2 shows the variation of daily demand of the month having the maximum variation in the maximum year of the ten year period. The average pumpage for the maximum month would be 126,700,000 gallons per day. The maximum sustained pumpage above the average monthly pumpage would be for the 8-day period from the 20th to the 27th inclusive, which would average 135,200,000 gallons per day. A reservoir large enough to take care of the 8-day sustained demand and the two days of highest pumpage, the 25th and the 26th, on which days the demand was 147,000,000 and 150,000,000 gallons per day respectively, would more than take care of all other variations in demand during that month, or any other month of the ten year period.

Curve 3 shows graphically the monthly variation in pumpage in the year having the greatest variation over the ten year period. You will note that the average pumpage of the maximum month would be 126,700,000 gallons per day as was also shown on curve 2. If the pumping station should work at a uniform rate of 100,000,000 gallons per day throughout the entire year, a reservoir having a capacity of 1,800,000,000 gallons would be required to take care of all the variations.

Curve 4 shows graphically the various capacities of the reservoir required to take care of all variations in demand throughout the year with pumping stations of varying capacity, it being assumed as before stated, that 100 per cent demand corresponds to an average yearly demand of 100,000,000 gallons per day.

A study of curve 1 showed that a 20,600,000 gallon reservoir would take care of hourly fluctuations on a maximum day of 150,000,000 gallons. With a station of larger capacity the size of reservoir decreases as shown on the curve. With a pumping station of less than 150,000,000 gallons per day, the two days of 147,000,000 and 150,000,000 gallons per day (to simplify say two days of 150,000,000 gallons per day demand) become the factor which determines the size of the reservoir up to the point where the 8 days of 135,200,000 gallons per day pumpage require greater reservoir capacity, which corresponds to a station of 130,000,000 gallons per day capacity.



Diagrams referred to in the accompanying article

The 8-day demand line crosses the line showing the reservoir capacity necessary to take care of the monthly fluctuations over a year's period at a pumping station capacity of approximately 124,000,000 gallons per day.

By combining these lines into one curve we can determine from the curve the size of the reservoir required to take care of any demands which will be made upon it over a year's period, with different capacities of pumping stations supplying the average demand.

Having determined from the curve the combination of sizes of pumping station and reservoir required to take care of all fluctuations in demand, we must next find out what the first cost of the various combinations is, in order to determine the most economical combination to construct, in so far as first cost is concerned.

The costs of the cribs, tunnels, pumping stations, reservoirs, etc., used are based on the average cost of Kirtland and Division tunnel systems and pumping stations, Fairmount, Kinsman and Warrensville reservoirs, and Division Avenue filtration plant. All capital operations and maintenance charges are based on pre-war costs. Since we are interested primarily in the ratio of the cost of one type of construction to another and not in the absolute cost, we believe the use of the comparatively stable pre-war prices is preferable to trying to change these costs to the present unstable basis.

We have tabulated below the approximate costs of our various waterworks projects, the average cost per million gallons of capacity for each, and the assumed life of the property upon which we based the annual fixed charges.

### Cost of Cribs, Tunnels, Aqueducts and Screen Wells

| | Kirtland System | Division Stysem |
|---|---|---|
| Type of crib | Permanent steel | Submerged |
| Diam. of tunnel system—ft. | 9 | 10, 7 and 5 |
| Length each sized tunnel | 26,000 | 16,100—9,200 |
| Total cost intake systems | $1,500,000 | $2,530,000 |
| Capacity tunnel system—m.g.p.d. | 175 | 175 |
| Cost per million gallons per day of capacity | $8,550 | $14,450 |

Average cost of cribs, tunnels, aqueducts and screen wells for Kirtland and Division systems per million gallons of daily capacity ....... ....... ..... .. $11,500

Assumed life of cribs, tunnels aqueducts and screen wells—100 years.

### Cost of Waterworks Land

The cost of land used for waterworks purposes has not been included in this comparison as the yearly appreciation of Cleveland waterworks land more than covers the yearly cost of the bonds which are required for its purchase.

### Pumping Station Costs

Buildings (pumping engine and boiler house)—Kirtland, $600,000; Division, $405,000.

Triple expansion pumping engines—Kirtland, $786,000; Division, $805,000.

Boilers, piping and miscellaneous equipment—Kirtland, 224,000; Division, $190,000.

Total pumping station cost—Kirtland, $1,600,000, Division, $1,404,000.

Ultimate capacity of pumping stations—m. g.p.d., —Kirtland, 165, Division, 165.

Cost per million gallons of capacity—Kirtland, $9,700, Division, $8,500.

Average cost of both stations per million gallons of capacity—$9,100.

Assumed life of complete pumping stations—30 years.

### Filtration Plant

Cost of Division Avenue filtration plant having a rated capacity of 150,000,000 gallons per day—$2,250,000.

Cost per million gallons of capacity—$15,000.

Assumed life of filtration plant—50 years.

Cost of low-lift building, pumps and proportional cost of boilers and miscellaneous equipment—$297,000.

Cost per million gallons capacity—$1,800.

Assumed life of complete low-lift pumping station—30 years.

### Distribution System Cost

We have assumed that the cost of the distribution system would be the same for direct as for reservoir pumpage, and have not included its cost in any data compiled herein.

### Reservoir Costs

Capacity of reservoirs—gallons—Fairmount—80,500,000; Kinsman—35,600,000; Warrensville—22,300,000.

Year completed, Fairmount—1885; Kinsman—1885; Warrensville—1914.

Cost of reservoir, Fairmount—$404,000; Kinsman—$159,400; Warrensville—$137,600.

Cost per million gallons, Fairmount—$5,300; Kinsman—$4,475; Warrensville—$6,170.

Average cost of three reservoirs per million gallons of capacity—$5,315.

Assumed life of reservoir—100 years.

In determining the capital, operation, and maintenance costs of the tunnel systems, pumping stations, filtration plants and reservoirs of proper capacity to take care of an average yearly demand of 100,000,000 gallons per day with pumping stations of various maximum capacities, a large number of assumptions had to be made and those having the greatest influence on this subject are shown diagrammatically in curve 5.

You will note from the curve labeled "Pumping Station Buildings, Cribs, Tunnels and Aqueducts" that we have increased the cost 80 per cent for double the capacity. This is due to the fact the unit costs of the tunnel systems and pumping stations would be somewhat less for the larger capacities, and the boiler house building would be relatively smaller due to the fact that the boilers could be run at higher ratings for short periods and the tunnel size could be relatively smaller for peak demands than for steady demands, as the friction loss could be somewhat greater for a peak demand of a given rate than for a steady demand of the same rate. The tunnel capacity does not exceed 150,000,000 gallons per day when used in connection with a filter plant, as the clear water basin is assumed to take care of the hourly fluctuations of filtered water pumpage.

The pumping station, boiler and miscellaneous equipment costs curve shows that the costs vary directly with the station capacity up to 150,000,000 gallons per day and that they increase 30 per cent more for a 225,000,000 gallon capacity station as compared with the 150,000,000 gallon station.

You will note from the curve that the filter plant capacity does not exceed 150,000,000 gallons as the clear water basin is assumed to take care of all hourly fluctuations throughout a maximum demand day.

We have made no increase in the cost of coal for the plants operating up to 130 per cent capacity, but have assumed that the coal cost would be gradually increased until it becomes 10 per cent higher for direct pumpage at a $225,000,000 gallon peak than for a station which would only have to pump a maximum of 130,000,000 gallons per day.

With the direct system of pumpage, pumps and boilers run at a lower load factor, as the station must be ready at all times for large fluctuations in demands which would result in a somewhat lower over-all station duty and resulting increase in coal consumption.

The pumping station supervision and operation is assumed to increase 60 per cent for an increase in pumping station capacity of 125 per cent. The cost of tunnel operation, which includes cribkeeper's salaries, etc., remains the same irrespective of the size of the tunnel.

The open reservoir unit costs have been assumed to vary from $5500 per million gallons for a 10,000,000 gallon reservoir to $5000 per million gallons for a 200,000,000 gallon reservoir. The cost of the covered reservoirs is assumed to be double that of the open reservoirs.

Reservoir operation costs consisting of keeper's and gardener's salaries vary from $115 per million gallons for a 10,000,000 gallon reservoir to $15 for a reservoir of 200,000,000 gallons capacity or over.

Filter plant supervision, labor, chemicals and supplies are assumed to be the same over a year's period, whether the plant operates steadily at a 100,000,000 gallon rate or filters up to rates of 150,000,000 gallons per day, although with a plant taking care of a varying demand the chemical costs, for instance, might be slightly higher.

By the use of curves 4 and 5 and the tabulated costs of the pumping stations, tunnel systems, etc., given above, we have determined the combined cost of various sizes of tunnels, pumping stations, filter plants and reservoirs required to take care of all variations in demand throughout the year. These costs are shown graphically on diagram 6.

Curve B represents the conditions of operation of Kirtland Pumping Station from its completion in 1904 to the present time.

Cure B represents the conditions of operation of the new Division Avenue Pumping Station and filter plant since its completion in 1917 to the present time.

Curve C would represent the conditions at Kirtland if it were a centrifugally equipped pumping station, after Baldwin reservoir is completed.

Curve D would represent the conditions of operation of Kirtland and Division pumping stations if they were equipped with centrifugal pumps and after Baldwin reservoir and filtration plant are completed.

The present tendencies point to a gradual change in many localities from triple expansion pumping stations and open reservoirs, to steam turbine driven centrifugal pumping stations and several reservoirs, and curves A, B, C, and D, show the comparative costs of these different types of construction.

The capital charges for conditions A, B, and D, are all approximately a minimum for a 130,000,000 gallon capacity pumping station and a 60,000,000 gallon capacity reservoir, and for the centrifugal station, filter plant and covered reservoir combination of curve D, the minimum cost would be for a 150,000,000 gallon capacity pumping station and a 20,600,000 gallon reservoir.

These curves also show that it would be just as economical from the standpoint of first cost to either build pumping stations of 225,000,000 gallons capacity for direct pumpage or open reservoirs of approximately 340 million gallons capacity for conditions A and B, and closed reservoirs of approximately 240,000,000 gallons capacity for conditions C and D with the corresponding sizes of pumping stations.

In the construction or reconstruction of waterworks, the first cost is of relatively less importance than the annual costs made up of operation, maintenance and fixed charges.

By the use of curves 4 and 5 and the assumptions given below, we have drawn curves E, F, G, and H, diagram 7, to show the combined annual operation, maintenance and fixed charges for various sizes of tunnels, pumping stations, filtration plants and reservoirs required to take care of all variations in demand over a year's period, assuming the average yearly pumpage to be 100,000,000 gallons per day.

In computing the annual fixed charges we have assumed the life of the various waterworks properties to be a certain number of years, and have added to the yearly maintenance cost the annual payment required to retire a serial bond in the amount of the cost of the property, the bond having the same life as the waterworks property being considered. In other words, the money borrowed to pay for the construction of the tunnels, pumping stations, filtration plants and reservoirs, will have been paid back by the time they have become obsolete or worn out.

In computing maintenance, we have determined from our records what per cent our maintenance costs have averaged over a long period of years, and have applied that percentage to the costs of the various waterworks properties.

The general method of varying the operating costs for the increasing size of tunnels, pumping stations, filtration plants and reservoirs, has been indicated above in the description of curve 5.

You will note that curves E and G are a minimum for 130,000,000 and 140,000,000 gallons per day respectively, while curves F and H reach their minimum points at 124,000,000 and 130,000,000 gallons per day respectively. The difference between these points in both cases is due to the fact that the cost of operation and maintenance of the triple expansion station with an open reservoir is relatively greater than for the centrifugally operated station with a covered reservoir and therefore the pumping capacity of the triple expansion station would be smaller than the centrifugal for the same annual costs. It will also be observed for curves F and H, which include a filtration plant, that the difference in pumping station capacity is 6,000,000, whereas for curves E and G, which do not include a filtration plant, the difference in pumping station capacity is 10,000,000. This is explained by the fact that the annual cost of the filtration plant is a relatively large per cent of the entire annual waterworks cost and therefore the difference in annual cost between the triple expansion open reservoir combination and the centrifugal covered reservoir combination is relatively less.

It is interesting to note that the annual operating costs would be the same for direct pumpage as for pumping station and reservoirs having capacities as follows:

Condition E—Pumping station capacity, 116,300,000 gallons; Reservoir capacity, 570,000,000 gallons.
Condition F—Pumping station capacity, 115,400,000 gallons; Reservoir capacity, 625,000,000 gallons.
Condition G—Pumping station capacity, 122,000,000 gallons; Reservoir capacity, 220,000,000 gallons.
Condition H—Pumping station capacity, 120,800,000 galons; Reservoir capacity, 295,000,000 gallons.

We would like to add here, as a matter of interest, that we have plotted curves using entirely different assumptions than were used in the plotting of diagrams 5, 6 and 7, and the general characteristics of the first cost and annual cost curves corresponding to diagrams 6 and 7 were not materially changed, which would indicate that the curves submitted cover a rather broad field in a general way. We have not included the additional curves or a discussion of them, as we did not wish to burden this paper with the further data.

In order to simplify the problem as much as possible, we have not included in our costs the additional investment which would be required to provide a reserve capacity for either pumping stations or reservoirs. We find, however, that our disregarding this item does not appreciably affect the data contained herein.

It is evident that the reservoir of most economical

*No. 31*

## *Canada's Contractors—Joseph Gosselin*

Joseph Gosselin, president of Joseph Gosselin, Limited, contractors of Levis, P. Q., is one of the best known figures in the construction industry of Eastern Canada. A man of practical experience and a hard worker, he has built up an extremely large business, handling a wide variety of building work throughout the province of Quebec. Mr. Gosselin was born in 1847 and after farming with his father, apprenticed himself to a carpenter. His first piece of work was the interior of St. Henry Roman Catholic Church, at Levis. Since then he has built a very great number of church institutions and, indeed, has handled nearly all the Roman Catholic churches in that part of Canada. He has not confined his activities, however, to the construction of religious edifices, but has built a large number of banks, business buildings and large residences. A number of bridges have also been contracted for by this firm.

It would be impossible to present in the space available a complete list of the work which has been handled by Mr. Gosselin, but among the more outstanding of his contracts might be mentioned the Transcontinental Railway Shops at St. Malo, P. Q.., a $2,000,000 job, calling for the construction of 11 buildings; the provincial library and customs houses for the province of Quebec; Tuberculosis Hospital, St. Foye; new grand stand, Exhibition Grounds, Quebec; freight shed and grain galleries for the Quebec Harbor Commission; the new Maritime shops for the Davie Shipbuilding Railways Company, at Lauzon, P. Q., etc. etc. This list meagre as we have had to make it, indicates however, that Mr. Gosselin is one of the big contractors of Eastern Canada and that he has the experience and organization to handle contracts of all kinds and of all sizes.

Mr. Joseph Gosselin

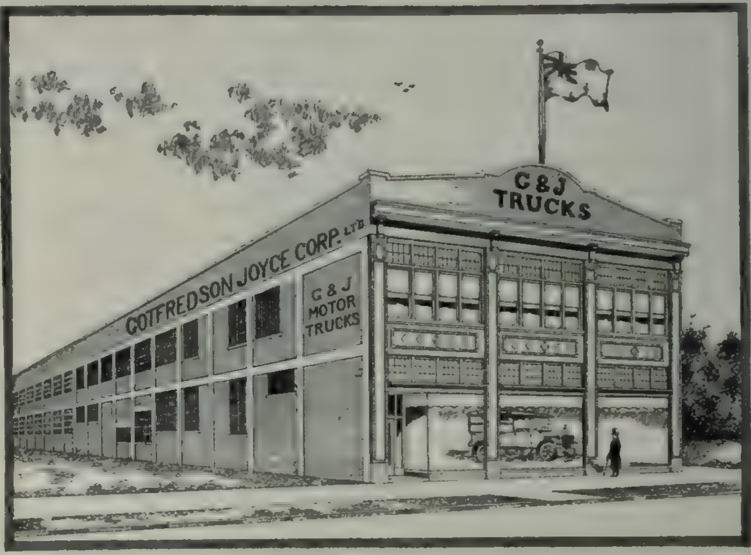
combination would be required to change its contents 60,000,000 gallons, and a reservoir which would change 60,000,000 gallons in capacity would presumably be one of at least 80,000,000 gallons in actual total capacity, so that a reasonable reserve would be available for emergencies at all times. The cost of this additional capacity would be approximately the same as the cost of the necessary reserve pump capacity which would be required at the pumping station.

Few waterworks are planned without provisions being made for continuous growth at a greater or less rate. The doubling of a size of a pumping station originally designed for such an extension could be done quite economically. However, another basin could be added to a reservoir which had proper provision made for it in the original construction with equal facility, so that in the matter of providing for future growth the pumping station and reservoir are not greatly different.

In conclusion, we believe that a study of the curves and data discussed herein will give one a fair idea of the relative merits of reservoirs as compared with additional pumping capacity for takig care of the various fluctuations in demand that a waterworks system is called upon to meet. The inherent ease with which a reservoir can meet large and rapid fluctuations in demand, its great value as an emergency reserve, as well as its economy in annual cost, make possible its great value for waterworks service.

For conditions of demand similar to those discussed, the use of the direct system of pumpage would be a questionable economy even though reservoir sites were not available, as a study of the curves indicate that steel or concrete tower tanks of several times the unit cost of reservoirs, could be constructed to take care of hourly fluctuations with considerable resulting economy.

## Big Garage For Toronto



Work has just commenced on the new garage, service station, offices and show-room for the Gotfredson Joyce Corporation, Limited, at 242 Spadina Ave., Toronto. .John V. Gray Construction Co., Toronto, have the general contract at a price of approximately $80,000, while the plumbing and heating has been awarded to A. Welch & Son, at $11,000. The building will measure 51 x 210 ft. and will have two storeys. The general details are indicated in the accompanying cut.

### Increase in Value of Land Near Windsor Bridge

Reports are already current of increases in the value of land in the vicinity of the proposed international bridge at Windsor, Ont. Some of these values have jumped 100 per cent. since the recent meeting of financial men in Toronto, which confirmed the proposal to erect this huge bridge.

## Mainly Constructional

**East and West—From Coast to Coast**

Fire losses in Canada during the week ended Nov. 30 are estimated by the Monetary Times at $258,500, compared with $334,000 the previous week.

Mr. A. E. Shaw, of New York, was in Edmonton, Alta., recently, in connection with the proposed construction of a $500,000 summer hotel, at Jasper Park, by the company which he represents.

To the rural municipality of Montmartre, Sask., go first honors this year in the annual provincial road dragging contest. Montmartre won the grand prize of $250 and the district prize of $175. The rural municipalities of Tecumseh and Harris captured the second and third prizes respectively.

For a registration fee of two dollars anyone interested may take a two week's course at the University of Toronto in civics and town-planning. The course, as outlined by the Extension Department, will open on January 9 at 10 a.m., and continue from 9 till 5 o'clock each day until January 21.

Building permits issued at Toronto, to the end of November, totalled $21,777,756, a decrease of $2,889,893 for the eleven months compared with this period last year. In November, however, they amounted to $2,005,680, an increase of $189,680 over the same month last year.

The city council at Quebec, P. Q., decided recently to make application to the government for an additional $1,000,000 to carry on house building in that city. House building activities in this city have been brisk during the past season and applications for loans are still pouring into the Housing Commission's offices.

A company known as The Stadium of Ottawa, Limited, with a capital of $300,000, has been incorporated to erect a stadium in that city, to be used for ice skating and hockey in the winter time, and for convention purposes, exhibitions, etc., during the other seasons of the year. Dr. J. L. Chabot is the president and Mr. Frank H. Plant, vice-president, of the new company.

November building permits issued at Vancouver totalled $168,510 in value, an increase of approximately $20,000 over the figure for the same month last year. The total value of permits issued for the present year, to the end of last month, is $2,942,993 as compared with $3,388,968 for the same period last year. The number of permits, however, issued this year is considerably greater than last year, which would indicate that this year's work has been of a smaller character.

The County Council of Kent, Ont., were the guests of the town of Tilbury recently, on the occasion of the opening of a new stretch of roadway from the C. P. R. station to the town limits. The visitors were also shown over other sections of roadway in the town constructed during the past season. Luncheon was served at the Empire Hotel and was followed by several short speeches by many prominent men on subjects of road interest.

Mr. Clarence Wallace, of Wallace Shipyards, and a member of the recently organized Burrard Dry Dock Company, at Vancouver, B. C., recently addressed the Shipping Bureau of the local Board of Trade, outlining the new company's plans for the construction of the dry dock. This new floating dry dock will be of composite construction, will be erected in two sections, with provision for future enlargements. A pier, 50 ft. by 700 ft. will also be constructed in connection with the dry dock. A start on the work will be made immediately, about 1,000 men being employed.

### Personal

Col. B. C. Battye, Royal Engineer of London, England, is a visitor in Ontario. He was sent out to this country by the Indian and Punjab Governments to study the organization and development of the Hydro-electric Power Commission.

Mr. Charles McKergow, Professor of Engineering at McGill University, Montreal, was the chief speaker at a recent luncheon of the Rotary Club, held at the Windsor Hotel in that city. It was "Engineering and Construction Day" at the Rotary Club, and Prof. McKergow's subject paid tribute to the part the engineer has taken in the world's progress.

Mr. Thomas H. Byrne was recently apointed road superintendent and engineer for the County of Carleton, Ont., succeeding Mr. Samuel McClure, who resigned recently. Mr. Byrne, who has been on the staff of Carleton County Council for several years, as advisory engineer to the Road and Bridges Committee, is a member of the firm of Patterson & Byrne, civil engineers and land surveyors, of Ottawa.

Mr. F. G. Whittaker, municipal engineer of South Vancouver, has been appointed city engineer of Prince Rupert, B. C. succeeding Mr. F. S. Clement, according to a recent dispatch. Mr. Whittaker obtained his engineering training in England, coming out to Canada in 1914. He has been connected with the municipality of South Vancouver, in an engineering capacity, since July of that year.

### Obituary

Another member of the fast diminishing group of construction engineers who were responsible for the establisment of the Canadian Pacific Railway system, has passed away, in the person of Mr. T. A. Stewart, whose death took place recently at Vancouver. Deceased was born in Londonderry, Ireland, in 1858, coming to this country several years ago and taking up residence in New Westminster. He was connected with the early construction work of the C. P. R. in the West, under Mr. H. J. Cambie.

Mr. Thomas A. Hodgson, prominent contractor of Ottawa, died recently in that city after a short illness at the age of 71. Mr. Hodgson was born at Whitby in 1850, going to Ottawa when a young man. He had been connected with the contracting business all his life, first with his father, Mr. William Hodgson, founder of the firm of William Hodgson & Son, and later in business for himself. Deceased retired from business two years ago, but operations were carried on by his son-in-law, Mr. A. E. Ford.

Mr. Benson McNichol, well known architect and contractor of Woodstock, Ont., died recently in that city, following a lingering illness. Deceased was born in Beverley Township, Ont., and took up residence in Woodstock in 1880. Mr. McNichol was a member of the city council in Woodstock for several years, being at one time mayor.

### Trade Incorporations

L'Association de Construction, Limitee, capital $499,000, with head office at Montreal, to carry on the business of building contractors in all branches.

The Law Construction Company, Limited, with head office at Toronto, capital $250,000, to carry on the business of general contractors.

# CONSTRUCTIONAL ACTIVITY

## Period of December 7 to December 13, 1921

***Dominion Wide Service Exclusive to "Contract Record & Engineering Review"***

## Waterworks, Sewerage and Roadways

**Burgessville, Ont.**
Construction of tile drainage system is contemplated by North Norwich Twp. Council. C. E. Burgess, secy.-treas., Burgessville, Ont.

**Fairground, Ont.**
Plans will be prepared for drainage system for Houghton Twp. Council. W. V. Stevenson, clerk, Fairground.

**Gananoque, Ont.**
Town Council will construct pavement on Main St. James, Proctor & Redfern, Ltd., Engrs., Excelsior Life Bldg., Toronto.

**Hamilton, Ont.**
City and Barton Twp. Councils plan road improvements costing $13,000 at head of James St. E. R. Gray, Engr.

City Council plan widening King St. from Margaret St. to McKittrick Bridge. E. R. Gray, Engr.

**Ottawa, Ont.**
City Council plan grading of Mann Ave.

City Council will construct watermains on various streets at estimated cost of $42,325. A. F. Macallum, Commr. of Works.

**St. Catharines, Ont.**
City Council plan construction of sanitary sewers on Ravine and Thorold Rds., Lincoln Ave., and Warren and Capner Sts. W. P. Near, Engr.

**Smith's Falls, Ont.**
Sewer costing $18,000 is being constructed by Town by day labor. J. A. Lewis, Engr.

### CONTRACTS AWARDED

**Dunnville, Ont.**
General contract for sewers costing $8,810 for Town is placed with Webster Construction Co., Ltd., Bank of Toronto Bldg., London. Frank Barber & Associates, Ltd., Engrs., Jarvis St., Toronto.

**London, Ont.**
Ohio Well Digging Co., Massilon, Ohio, will construct wells for waterworks for City.

**Regina, Sask.**
General contract for construction of highway at cost of $30,865 from south of Fleming to Wapella, Sask., for Prov. Govt., Dept. of Highways, Regina, is awarded to M. Gaffield, Red Jacket, Sask.

## Railroads, Bridges and Wharves

### CONTRACTS AWARDED

**Montreal, Que.**
General contract for construction of car cleaning shops costing $50,000, at Glen yards, for C. P. Rly. is awarded to D. G. Loomis & Son, 211 McGill St.

**Shequiandah, Ont.**
McNamara Bros. & Thornton, Sault Ste. Marie, Ont., have general contract for repairs to wharf, Manitoulin Island, Algoma District, for Dom. Govt., Dept. Pub. Works.

**Vancouver, B.C.**
General contract for repairs to wharves costing $7,000 for Dom. Govt., Dept. Pub. Works, is awarded to Vancouver Piledriving Co., Ltd., 207 Hastings St. W.

## Public Buildings, Churches and Schools

**Montreal, Que.**
Plans are being prepared for alterations and extension to Arts Bldg. to cost $300,000 for McGill University, Sherbrooke St. W. Fetherstonhaugh & McDougall, architects, 85 Osborne St. Chas. J. Saxe, Consg. Architect, 364 Dorchester St. W.

**North Vancouver, B.C.**
Erection of school at cost of $15,000 is contemplated by North Vancouver School Bd.

**Ottawa, Ont.**
W. E. Noffke, architect, Central Chambers, will prepare plans for public lavatories for City.

**Star City, Sask.**
Ratepayers passed by-law authorizing expenditure of $30,000 for erection of school. David Webster, architect, 212 C.P.R. Bldg., Saskatoon.

**Teeswater, Ont.**
W. E. Binning, architect, Listowel, is preparing plans for addition to school to cost $40,000 for School Bd.

### CONTRACTS AWARDED

**Cadogan, Alta.**
D. Hausman, Cadogan, has general contract for erection of school for School Bd.

**London, Ont.**
Additional contracts for High School costing $308,000 for Bd. of Education are: Desks, Geo. M. Hendry Co., Ltd., 215 Victoria St., Toronto; folding chairs, Smallman & Ingram, Dundas St., London; benches for manual training, John H. Campbell, 541 Dundas St., London; physics laboratory equipment, McKay School Equipment, 614 Yonge St., Toronto.

**Montreal, Que.**
Contract for asphalt required for school costing $500,000 for Protestant School Bd., 36 Belmont St., is awarded to G. W. Reed & Co., 37 St. Antoine St.

Plastering contract for Pathological Bldg. costing $460,000 for McGill University, Sherbrooke St. W., is placed with Peter D. Baxter, 207 St. James St. Painting contract is awarded to Goodwin's, Ltd., St. Catherine St. W.

Contract for seating for church costing $50,000 for Temple Baptist Church is placed with Globe Furniture Co., Waterloo, Ont.

**Prince Rupert, B.C.**
Electrical and plumbing contracts for court house for Prov. Govt. are awarded to Mundy, Rowland & Co., Standard Bank Bldg., Victoria, and Steel & Longfield, Prince Rupert, B.C.

**Salmon Arm, B.C.**
M. Vistaunet, 3150 Davin St., Victoria, has general contract for erection of High School costing $32,434 for Prov. Govt., Dept. Pub. Works. H. Whittaker, architect, Parliament Bldgs., Victoria.

**Toronto, Ont.**
W. H. Martin & Co., 28 Harcourt Ave., have general contract for erection of church costing $210,000 for Riverdale Presbyterian Church, Pape and Harcourt Aves. Additional contracts are: Steel, Reid & Brown, 63 Esplanade E.; cut stone work, Scott Bros., 38 Magee St.; steamfitting, W. G. McGuire, Ltd., 91 Jarvis St.; tile, Interlocking Tile Co., Ltd., 32 Toronto St.; roofing and galvanized iron, J. C. McFadden, 322 Danforth Ave.; art glass, Consolidated Plate Glass Co. of Canada, Ltd., 241 Spadina Ave.

Heating contract at $21,000 for Live Stock Arena at Exhibition Grounds for City is awarded to Purdy Mansell, Ltd., 63 Albert St.

Additional contracts for school for S.S. No. 7, York Twp., are: Electrical, Canada Electric Co., 173 King St. E., Toronto; plumbing and heating, A. Welch & Son, 304 Queen St. W., Toronto; painting, J. McCausland & Son, 11 Nelson St., Toronto.

Contracts for masonry, steel and brickwork required for church costng $20,000 for Bulgarian Mission are awarded to A. Hibbard, 195 Melita Ave.; Hepburne & Disher, 71 Van Horne St., and Thos. Purton, 53 Kenwood Ave. J. W. Gray, architect, Confederation Life Bldg.

Additional contracts for alterations and addition to fire hall costing $15,740 at corner College and Bellevue for City are: Masonry, Teagle & Son, 310 Davenport Rd.; carpentry, R. G. Kirby, 539 Yonge St.; roofing, Carmichael Waterproofing Co., 918 Palmerston Ave.; plumbing and heating, W. J. McGuire, Ltd., 91 Jarvis St.

## Business Buildings and Industrial Plants

**Buckingham, Que.**
M. A. Gauthier contemplates erection of store.

**Hamilton, Ont.**
Geo. T. Evans, architect, Clyde Block, is preparing plans for store to cost $15,000, to be erected on Barton St. E.

**Loverna, Sask.**
Flour mill is being erected by Geo. Hurley, Loverna, Sask.

**Montreal, Que.**
Bigonesse & Bigonesse, architects, 26 St. James St., are preparing plans for factory to be erected on St. Lawrence Blvd.

**Ottawa, Ont.**
City Council plan erection of market bldgs. on Market St.

**Port Credit, Ont.**
Erection of service station is contemplat-

ESTABLISHED 1886

# Contract Record and Engineering Review

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## *The Practice of Economy Needed to Secure Permanent Improvements in Business*

Much improved business conditions and a sentiment throughout the country reflecting courage are the features of the present economic situation noted by the National Bank of Commerce of New York in an analysis published in its monthly bulletin. In attributing a reason for these conditions, this authority states that such progress as has been made by the business community toward normal conditions results from a realization that artificial levels of activity will not again be reached in any period near enough to affect the problems of today, and from a determination to practice economies of operation more rigid than heretofore thought possible. The need of personal effort and economy is also being increasingly recognized in giving a day's work for a day's pay and in care as to personal expenditure. Business men and executives now recognize that henceforth they must give the most thorough personal attention and application to their enterprises.

Some part of the recent gain in business, further claims the Bank of Commerce, is unquestionably a result of seasonal demand. Permanent improvement depends to a large extent on foreign buying power, and even more on the adjustment of conditions under which the farmer operates. The last three years have clearly shown that the European situation can be stabilized only by the political and economic efforts of the countries concerned. Domestic conditions can be bettered by steady determination on the part of corporations and individuals to secure greater efficiency and to practice greater economy. This will result in gradual readjustment of the burden of price inequalities now resting on the farmer.

## *Lower Labor Costs Essential to Better Business Conditions*

That labor costs in many lines must be further reduced is another opinion of the National Bank of Commerce, supplementing those expressed in the article above. Such reductions can in part be attained by lower wages, and in part by increased efficiency in organization for production. A considerable part of labor inefficiency is at times due to actual defects in plant and organization and therefore, business has two duties, first, to provide the best means for efficient production by its labor, and second, to insist on a day's work for a day's pay.

Sales methods and policies must also undergo searching scrutiny in the opinion of this analyst. Salesmen face a buying public which is critical, cautious, poor and thrifty and only the most effective sales organization can sell in such a market. Decreased overhead charges, lowered unit production costs, maintenance of quality, and selling skill are necessary for the welfare of each individual producer and they are no less essential as steps toward better business for the entire country.

## *Building Costs Increased by Action of the Unions*

To what extent union abuses raise building costs has been made the subject of considerable discussion at the Lockwood committee investigation into the activities of the building materials men in New York city. The committee has thrown the light on certain operations of the unions that are extremely unfair and in many cases, criminal. As these operations are not restricted to New York or to the United States, a report of parts of the investigation will be of general interest and the following is therefore culled from the New York press:

The Lockwood committee opened a new phase of its housing inquiry by examining witnesses in an endeavour to learn as to what extent housing construction was loaded with high costs due to the inefficiency of labor. C. G. Norman, Chairman of the Board of Governors of the Building Trades Employers' Association, detailed a long list of abuses he alleged existed in building trade unions, resulting from severe membership and production restrictions demanded by the organizations.

Patrick J. Crowley, successor of Robert P. Brindell as chairman of the Building Trades Council, having jurisdiction over 115,000 workers, explained the inefficiency of labor by the phrase "more pay, more pep,' and declared he had heard no complaints lately regarding the inefficiency of labor.

Samuel Untermyer, senior counsel to the committee, and Henry Mayer, assistant counsel, took up the affairs of Inside Electrical Workers' Union 3, which is said to have collected $250,000 a year on "permit" cards which enabled non-union journeymen to work on union jobs if they paid $2.50 a week for journeymen's cards and $1 a week for helper's cards.

In introducing the examination of Crowley and Norman, Mr. Untermyer said the committee was about to take up a branch of the inquiry of great importance to the building industry and would want to

*No. 74*

## *Canada's Engineers—J. T. Morkill*

**A wide experience in railroad work has admirably fitted Mr. J. T. Morkill for the position he occupies as chief engineer of the Quebec Central Railway, an organization with which he has served for many years. In fact, it was with this company that he commenced in 1873 his practical engineering training as rodman. In 1878 he became assistant engineer of the same line, serving as chief engineer for part of the year 1881. For the remainder of that year and for the following year, he left the employ of the Quebec Central organization to become assistant engineer of the Imperial Brazilian, Natal and Nova Cruz Railway. After holding one or two other positions he rejoined the Quebec Central in 1884 and served for four years as its chief engineer. Other fields again attracted him and in 1889 and '90 he was engaged in making mining surveys and reports in Idaho. For a short period he was located in Londonderry, N. S., on track work and surveys in the iron mines. Experience in other enterprises then took up his time for several years, among the projects on which he was engaged being the Lotbiniere & Megantic Railway in Quebec, on which he superintended location and construction; the Magalia Mine in California, for which he was superintendent and engineer; and mines in Nevada and British Columbia. In 1900, Mr. Morkill joined the C. P. R. and served in various capacities, being employed in turn as assistant engineer on the Atlantic division, chief of locating party Sault Ste. Marie line, contractors' engineer at the Angus shops and chief of locating party on the Toronto to Sudbury line. In 1905 Mr. Morkill resumed once more his connection with the Quebec Central Railway, as chief engineer, a position which he has filled continuously to date.**

Mr. J. T. Morkill

expose the rules and regulations that make for inefficiency.

Mr. Norman then took the stand and said that the Building Trades Employers' Association had taken up the question of labor inefficiency and was systematizing its reports. He gave the results of some of the organization's labors as follows:

A general abuse is that a foreman is required to be a member of the union and is subject to trial and discipline by the union with the result that he does not dare to give the workers orders for fear of being called up on charges of "pushing" his men and "slave driving." The foreman is supposed to be the employer's man, but is powerless to serve the former's interests.

In the bricklayers' and carpenters' unions the employer is permitted to have his own foreman who need not be a union man.

The cement masons' union compels the employer to have a foreman on every job even if but one man is doing the work. He then becomes foreman at an advance of $1 a day over his pay as a journeyman.

Although the architects and owners of new buildings may be satisfied with the artistic appearance of panels or mantels supplied to members of the Plasterers' Union for setting on ceilings or walls, the union men refuse to put up the panels if they have been bought ready made after having been cast in an outside shop. The men claim the right to "run" all panels themselves on the ground that it gives their men more work.

Though the architects and owners may be satisfied with the work, the shop stewards of the plasterers' union have a right to "inspect" the work and order it taken down if they are not satisfied with it, said Mr. Norman.

The plasterers' union threatened to call off its men in the case of a job on the Hotel Plaza, where some especially delicate molds were to be placed above a door. In this case the moldings could not possibly have been "run" on the wall by the men, said the witness, and had to be cast in a shop. He said the case was so extreme that he took it up with John Donlin, chairman of the building trades department of the American Federation of Labor, who had to confer with the local union officials.

A ceiling that had been "cast" and placed in position in the Hotel Ambassador had to be torn down because of this restriction, according to Norman. The Hotel Commodore changed its ceiling plans because of the union's restrictions.

"By putting a scoop of plaster of paris in the ingredients for mantels, four could be made in a day," he continued. "The union forbade the practice, and so only one mantel can be made in a day.

### Slack Work Induced

"Take the bricklayers. In one case a gang of men were complimented for laying 1,000 bricks a day. The next day, after the delegate spoke to them, they laid 800, and 700 the third day. The employer then told them they could not have their pay unless they returned to 1,000 a day. The next day the gang laid 1,000. Before the war they laid 1,200 and 1,400 and even 1,800.

"The slacking and inefficiency is due to the fact

Continued on page 1110

I have always thought of CHRISTMAS as a good time; a kind, forgiving, generous, pleasant time; a time when men and women seem by one consent to open their hearts freely and so I say God Bless Christmas.

DICKENS

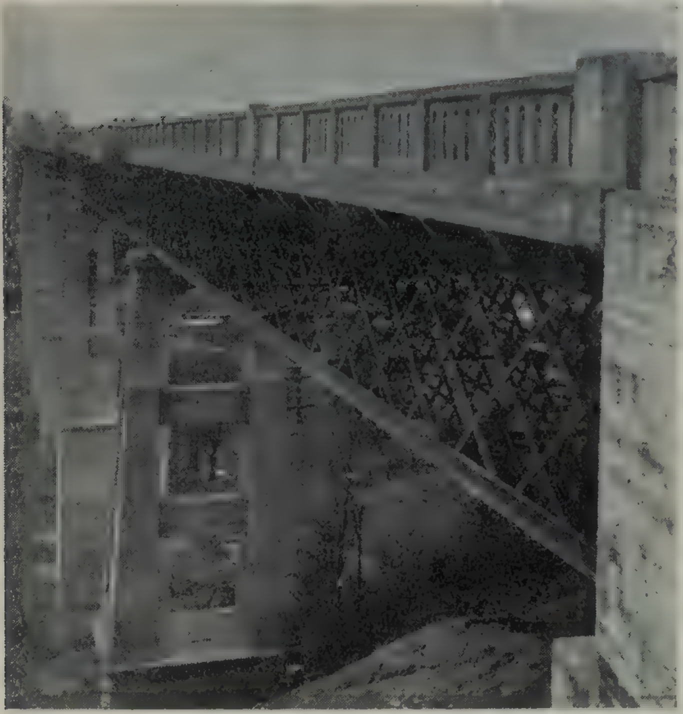
*—Good wishes*
*from the*
*staff of*
*The "CONTRACT RECORD*
*and Engineering Review"*

This bridge, 993 ft. long and 118 ft. high, spans the Sixteen-Mile Creek on the Dundas Road between Toronto and Hamilton, Ont.

# Large Bridge Eliminates Bad Crossing on Road from Toronto to Hamilton

## Ravine Formed by the Sixteen-Mile Creek is Spanned by a Thousand Foot Structure—Bad Turns and 16½% Grades are Avoided—Cableway Used for Construction Operations

Yesterday afternoon the official opening of the Sixteen-Mile Creek bridge on the Dundas Road, between Toronto and Hamilton, took place with appropriate ceremonies. The event was the occasion for the gathering together of a large number of highway officials, good roads advocates and public dignitaries. The Hon. F. C. Biggs, Minister of Highways for Ontario, was the chief representative of the provincial government at the dedication and officially declared the bridge open to traffic.



The Sixteen-Mile Creek bridge comprises concrete piers, steel latticed trusses and concrete deck and handrailing

This bridge is one of the largest that has been constructed on the Ontario provincial highway system. It crosses the deep ravine formed by the Sixteen-Mile Creek, at Dundas Street, which road was taken over by the provincial highways department and is undergoing reconstruction to fit it as a direct thoroughfare from Toronto to Hamilton. On completion of this bridge, Dundas Road will be free of any but nominal grades, inasmuch as the only other impediment along the road, namely the deep ravine over the Twelve-Mile Creek was bridged by a high level structure two years ago. An article descriptive of the latter bridge, which is similar in type to the one described herein, appeared in the Contract Record of January 7, 1920. The general design of these two structures is identical and the contracting methods were alike, although the Sixteen-Mile Creek bridge--the subject of the present article--is much longer and higher than the Tansley structure.

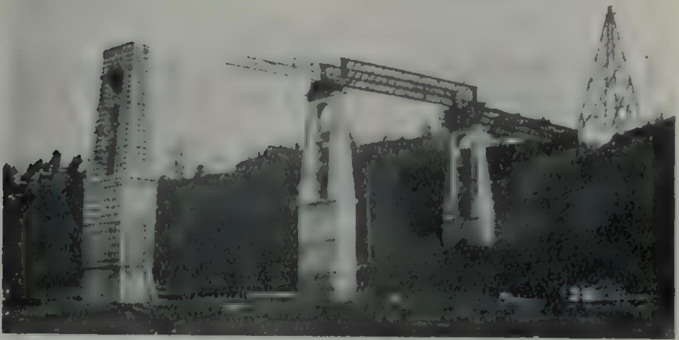
### Nearly 1000 Feet Long

The new bridge is 993 ft. long, comprising 8 spans of 108 ft. 6 in. each and two flanking spans. From deck to water level the height is 118 ft. The sub-structure comprises concrete abutments and piers, while the superstructure consists of concrete beams and deck carried on deck latticed trusses of 108 ft. 6 in. span and spaced 13 ft. 6 in. centre to centre. The width is 20 ft. from inside to inside of hand rails, giving a clear roadway width, allowing for curbs, of 19 ft. Unlike the Tansley bridge, the Sixteen-Mile Creek structure is not skewed nor placed on a grade, but is level and follows the centre line of Dundas Street. It was designed for Class "C" loading of the Ontario Department of Highways, (20 ton concentrated load).

Prior to the erection of this bridge, the crossing of the Sixteen-Mile Creek ravine was precarious and unsafe in wet weather, inasmuch as the road was on a 16½ per cent grade and detoured through the valley by sharp curves. The former bridge over the creek was a steel truss structure in fairly good repair, but with only a 16 ft. roadway. The construction of the new high level crossing was inaugurated by the County of Halton, which was also responsible for the Tansley bridge. However, before progress had advanced very far, the Provincial Highways Department announced its intention of taking over the Dundas Road as a part of the provincial highways systems and it, therefore, carrried on the construction of the bridge under its own direction. The actual construction and design were performed by Norman McLeod, Limited, contractors of Toronto, who also built the bridge over the Twelve-Mile Creek.

### All Operations Performed By Cableway

The construction of the bridge was largely a mechanical job, with the labor force kept to small dimensions. While the contractors' camp provided for fifty men, there were never that many on the pay roll. The chief part of the construction plant was a Florry 5-ton steel cableway, 1,200 ft. long, on wooden towers, 100 ft. high. Practically all operations in connection with the bridge including excavation, form handling, concrete pouring and erection of girders, were carried out by means of this cableway. It was operated from the west bank, at which point was also located the mixer plant, comprising a steam driven 1-yd. mixer, fed from overhead bins through measuring hoppers and discharging through a small section of chute into 40 cu. ft. bottom dumping buckets under the cableway. The aggregates were teamed or trucked in from the nearest siding, four miles away, and dumped on wooden platforms to be rehandled into the bins by a steam operated clam shell. Water for the mixer, boilers and for camp use was obtained from the creek, being pumped through pipes up the sides of the ravine. On the cableway tower, on the west bank, a 1,000 gal. tank was constructed to act as a reservoir.



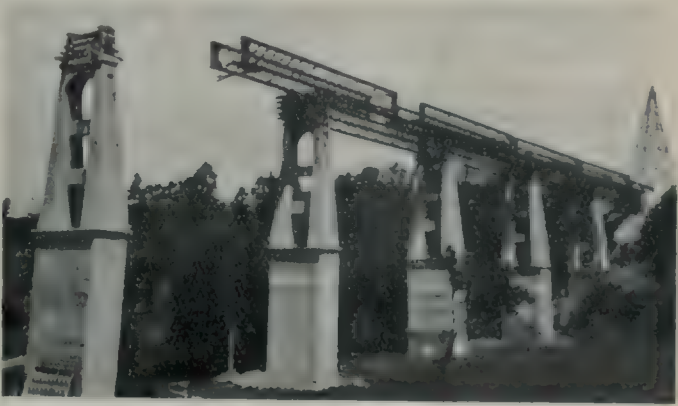
Falsework was not used for erecting the girders, but the cableway and a pilot truss were employed instead

No difficulty was experienced in the foundations, as shale was within a few feet of the surface. Water troubles were insignificant and a simple, but well constructed cofferdam was all that was necessary to secure water tightness at the piers near the creek bed. Piers consisted of two columns on solid bases, arched at the top and braced with two struts. They measured about 10 ft. by 20 ft. at the base and tapered toward the top. Reinforcement against temperature stresses was provided excepting the struts and knee braces, which were also heavily reinforced against wind stresses. The form work was built up of wooden sections and was alike for all piers. The concreteing commenced at the east end, piers being erected in order toward the west end, which was the operating side of the contractor's plant. While there were not two complete sets of forms, it was possible to pour the lower part of one pier while concreteing the upper part of the adjacent pier, owing to the possibility of removing the lower sections of forms after the concrete had set and erecting them on a new pier. While the contractors did not aim to establish any records in the matter of pouring concrete, it is of interest to note that the plant was capable of large capacity operations. For example, in pouring the most easterly pier, it was found possible to mix a 40 cu. ft. batch of concrete, haul it 1,000 ft. on the cableway, pour it and return the bucket to the mixer every six minutes. It was not possible, or necessary, to keep this record up, however, as the fact that the cableway was employed for other operations prevented continuous pouring of concrete.

### Girders Erected By Pilot

The steel girders were originally on old Intercolonial Railway bridges that had been replaced by heavier structures, The chords consisted of two 12 in. channels and 24 in. cover plates and the web members comprised a double system of angles and bars forming 5 ft. panels. They were demonstrated to be amply serviceable for highway use. New brace frames and laterals were installed prior to erection.

An interesting feature of the construction was the fact that these girders were erected entirely without false work, the girders being carried across the openings by means of a pilot or pair of triangular trusses, 60 ft. long, suitably cross braced. This pilot was bolted on the end of the girders and securely tied to the shoe plates. The pilot was handled by the cableway and connected to the girders as soon as the latter were out far enough to enable the pilot to reach the pier. Each girder was pulled from the forward end of the last girder placed, moving on greased rails, the motive power being supplied by the carriage of the cableway, with a series of blocks and tackle. When the girder was moved out to its proper position, it was jacked down to its bearing on the pier. The next girder was then run out over those in place and erected in a similar manner.

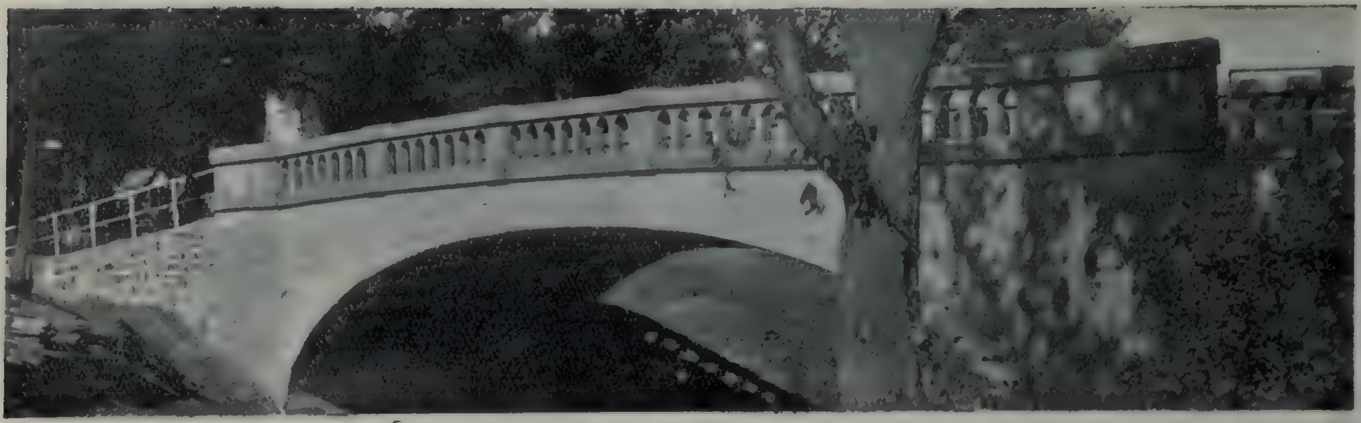


Each girder was taken out in turn over the girders already placed

When the girders were erected, form work for the deck was placed and the concrete poured. Reinforced concrete beams are placed at 5 ft. centres and are covered with a 7½ in. slab. The curbs were cast integrally with the deck. The hand railing consists of pre-cast panels set up in position in chaces left in the curb. Forms for the posts and upper rails were then clamped around them and the concrete poured.

The bridge was constructed and designed by Norman McLeod, Limited, contractors, of Toronto.

Fire losses in Canada during the week ended November 23rd, are estimated by the Monetary Times at $334,000, compared with $287,850 the previous week.



Reinforced Concrete Bridge at St. Roch des Aulnaies, P. Q.

# Concrete Bridges on Quebec Highways

## 70 Ft. Span at St. Roch des Aulnaies, P. Q., is Typical of the Structures Which the Quebec Government is Erecting on its Rural Road System

By the Contract Record's Quebec, P. Q., Correspondent

Good roads also mean good bridges. The good roads policy which was set forth, some ten years ago, by the government of the province of Quebec is well known to everybody; much energy has been displayed in making a good highway system throughout the province and the results, so far, have been up to expectations. As a consequence of that widespread movement for better roads, new and better bridges have been required everywhere and the technical branch of the Department of Public Works and Labour, that controls the design and erection of bridges under superintendence of I. E. Vallee, chief engineer, has become one of the busiest services of the provincial adminstration.

Structural steel has been used almost exclusively in the past for spanning streams and rivers in the province of Quebec but now concrete is being given special attention.

The accompanying illustration shows a new bridge which has been erected, a short time ago, over the River Ferree at St-Roch des Aulnaies, county of L'Islet. Its neat and artistic appearance indicates the possibilities of concrete construction in matching the pretty scenery which the tourists are sure to find along our country roads.

This bridge is 20 feet wide, has a clear span of 70 feet and was erected within one month's time. It consists of a reinforced concrete arch with plain concrete side-walls and railings. It was designed to carry a concentrated live load of 15 tons. It is filled with gravel to the proper grade. The foundations rest on solid rock. 350 cubic yards of 1: 2: 4 concrete and 5000 lbs. of steel, consisting of 3/4 in. twisted bars, 1/2 in. and 3/8 in. round bars, were used. The total cost, including the approaches, was $9,300.00. The contractor was Zephirin Cloutier, of St. Pierre de Montmagny, who had retained the services of C. C. Lessard, C. E., to supervise the erection. The bridge was designed by Ernest Lavigne, C. E., who has specialized in that kind of construction and is now on Mr. Vallee's staff, in charge of the designing and inspecting of all the concrete bridges.

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# New Fire Station in West Ward, City of Sherbrooke, P. Q.

By our Sherbrooke Correspondent

A new fire station costing $25,000 is being erected in the West Ward, city of Sherbrooke. Well located on the south west corner of Belvidere and McManamy Street, it will fill a long felt want in the best industrial part of the city.

Work is being done according to plans and speci-

Sherbrooke's new fire station

fications prepared by Mr. J. W. Gregoire, architect, Sherbrooke, under a general contract awarded to M. M. Royer & Boislard, general contractors, Sherbrooke.

This new fire station, which will be "No. 5" in Sherbrooke, is to be equipped with the latest appliances and fire protection equipment. It is a solid brick building, 50 ft. wide by 64 ft. deep, with a 10 ft. 6 in. square, 50 ft. high tower, which is provided with a 3,600 ft. capacity hose hanger and electric warmer for drying the hose in severe cold weather.

Two storeys high, the ground floor will carry the fire equipment, stable space for six horses, etc., while half the first floor will be used for office, dormitory, toilet and store-room for hay, oats, etc. The other half is a six-room tenement for the officer in charge and his family.

The building is planned to be completed during next summer.

### Building Show Postponed

Postponement of the American Building Exposition, Cleveland, from January 4th to February 22nd, has been forced by the failure to have the new municipal auditorium completed in time for the earlier date. The exposition will run 11 days and conclude on March 4th. It will demonstrate home, commercial and factory construction and equipment.

Sponsored by the Builders' Exchange of Cleveland, the exposition is blazing a new trail in its particular field through its co-operation, non-profit plan which furnishes all who participate their display opportunity at actual cost. Only the exhibitors will derive any financial benefit from the show, as all profits are to be rebated to them pro rata.

Both floors of the auditorium will be utilized and the exposition will be the opening attraction.

An attendance of at least 250,000 is anticipated.

# Large Coal Handling Plant at Sarnia

## Unloading Equipment at the Works of Imperial Oil Ltd., is the Latest Development in This Class of Machinery—Installation is Completely Canadian

It is always fascinating to watch the rapid unloading of a mammoth steamer by automatic machinery, and the Imperial Oil Limited's new coal unloading plant represents the latest development in this class of equipment. It is particularly interesting to Canadians because of the fact that the design, fabrication and installation of the complete vlant was the work of a Canadian company, and the automatic machinery in its entirety built in a Canadian factory.

The refinery at Sarnia is the largest in Canada and the consumption of coal in the company's water hogs and stills approximates 200,000 tons annually. The coal is received at the dock in huge steamers specially constructed for this purpose, and carrying cargoes of 6,000 tons. This coal is taken from the hold of the steamer by movable towers, each equipped with an automatic grab bucket having a capacity of about 3000 lbs. The hoisting of these buckets is accomplished by direct acting steam engines, one in each tower, and the operation of hoisting in each tower is

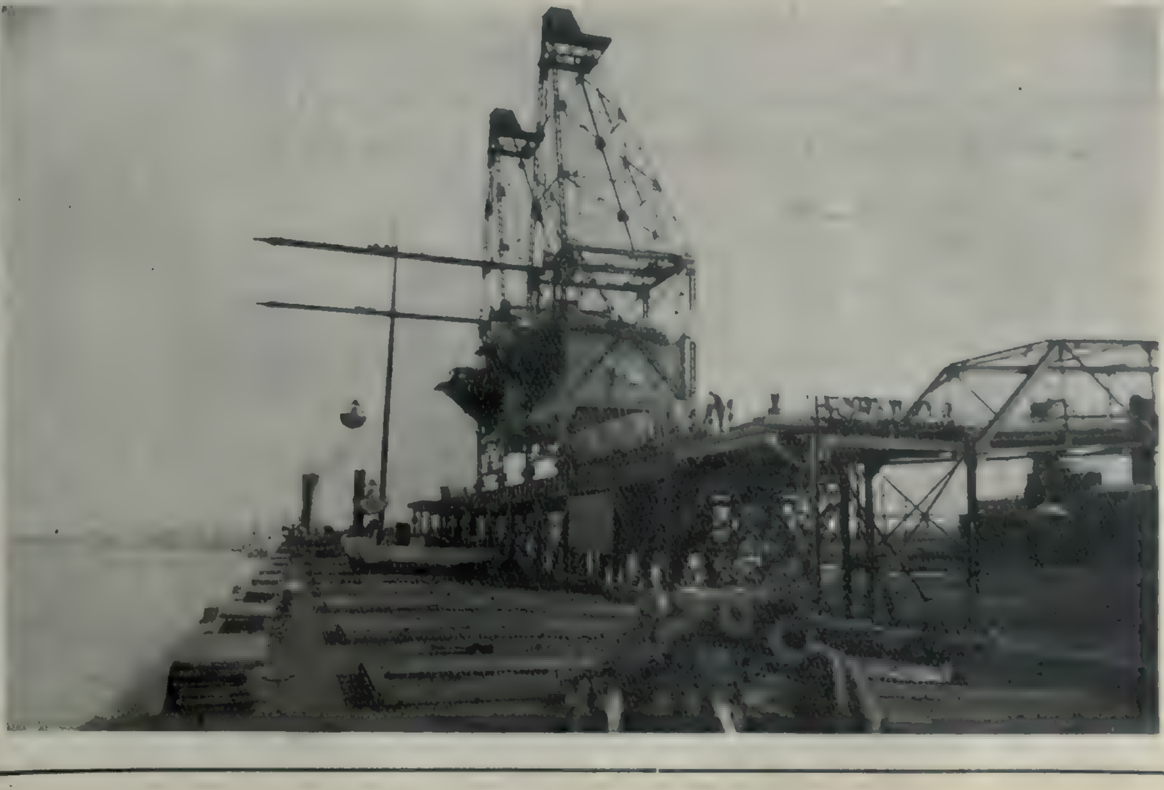


Fig. 1
Unloading towers in operation

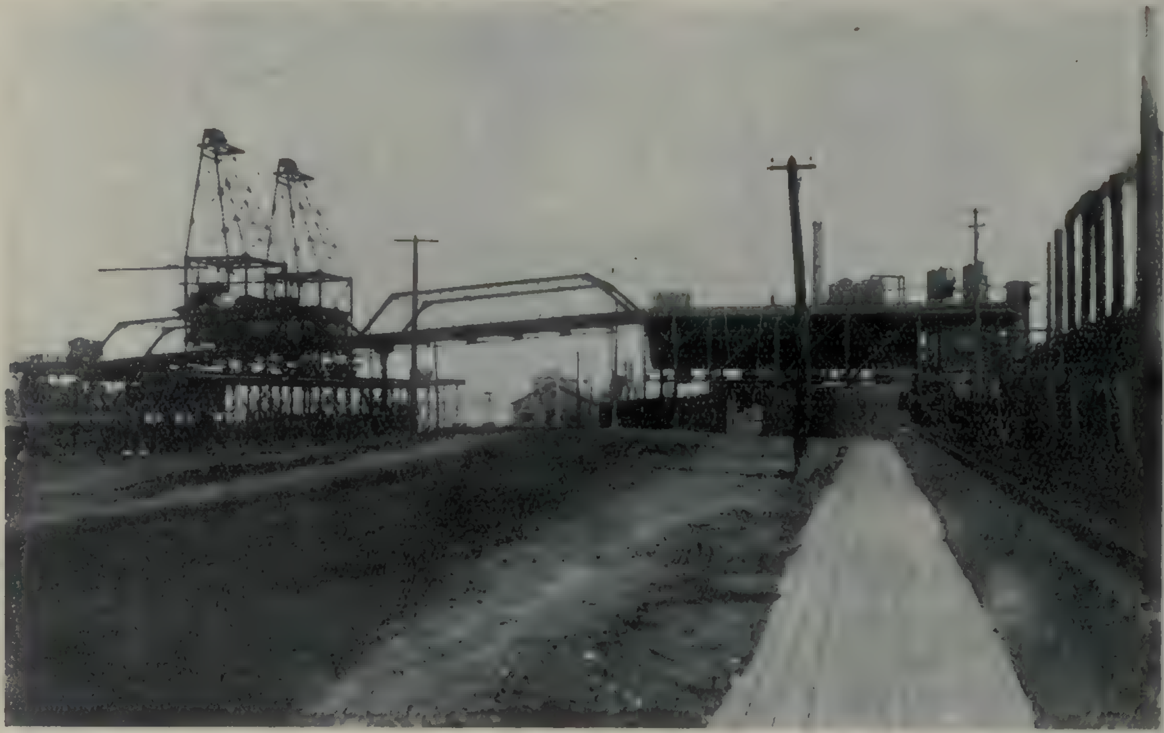


Fig. 2. A general view of the coal handling plant at the Sarnia, Ont., plant of Imperial Oil, Ltd.

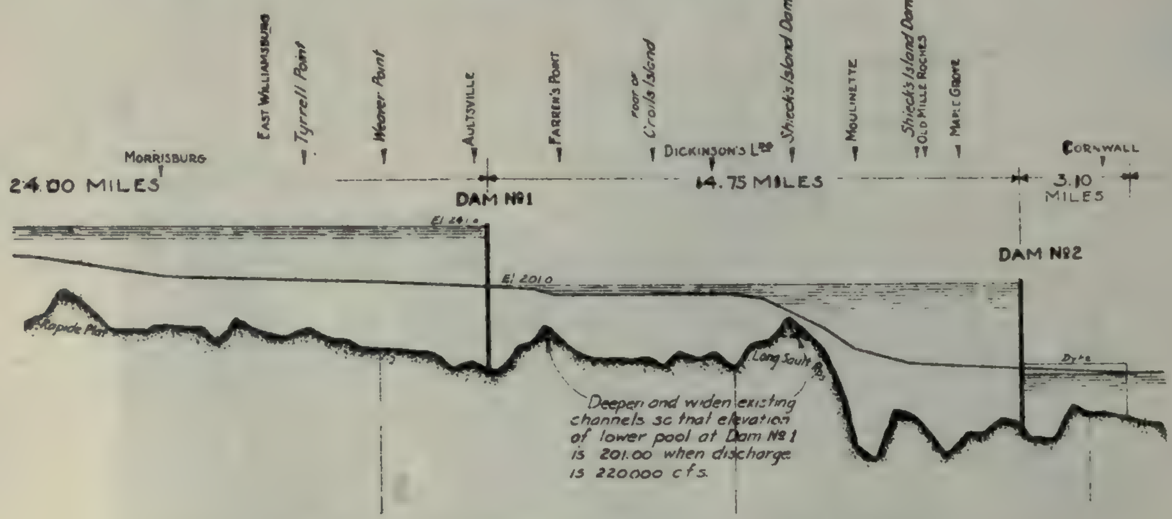
accomplished by one man only. The coal is elevated a distance of about 50 ft. and discharges into cable cars running on an elevated trestle for carrying the coal across the railroad tracks and public street into the Imperial Oil yard, where the coal is discharged into a large pocket for distribution to the various portions of the plant by means of auto trucks.

Fig. 1 shows the two unloading towers in operation. Each tower has an unloading capacity of 250 tons per hour giving a total of 500 tons for the two towers. Fig. 2 is a panorama of the new coal handling plant showing the unloading towers at the left, and the auto truck loading pocket at the right.

The present plant is laid out so that eventually the cable road conveying system can be extended a distance of about half a mile, so as to deliver coal direct to the various stills and power plants and also to the storage pile.

The complete plant was designed, manufactured and constructed by the Canadian Mead-Morrison Company, Limited.

## Hydro-Electric Power Development on the St. Lawrence River



A profile of the scheme suggested by Hugh L. Cooper & Co., consulting engineers, New York and presented before the International Joint Waterways Commission.

# Extraction of Bitumen from the Tar Sands of Northern Alberta

## Provincial University, Through the Industrial Research Department, is Trying to Solve the Riddle Locked up in the McMurray Bituminous Sand Deposits—Important Relation of the Problem to Road Building

By Dr. K. A. CLARK, Road Engineer, Alberta, in the University of Alberta Press Bulletin

The Industrial Research Department of the University of Alberta has undertaken the study of a separation process for reclaiming the bitumen from the "tar sands" that are prevalent in certain portions of the province.

Bitumen from the "tar sands" may prove to be the remedy for Alberta muddy roads.

Probably no other natural resource of the province holds quite the lure and fascination for the public mind as the "tar sand" deposit of Northern Alberta. While the scramble for oil goes on, and while we wait in expectancy till some of the drill-holes going down all about us shall tap some hidden petroleum pool, the "tar sand" deposit stands plainly in view, the biggest thing of its sort in the world, for anyone who passes to see. The deposit contains more mineral oil than the whole world could use for some time to come. But because no one has yet discovered the secret of how to take the oil away, it remains there, year after year, unmolested. Many have looked for the secret. Samples of the "tar sand" have found their way far afield, and many technologists have given the material more or less of their thoughts and attention. But still the deposit remains unexploited.

The province of Alberta has recognized the futility of waiting for the development of this resource as the result of the efforts of outsiders, and has decided to shoulder the burden of her own problem. The answer to the "tar sand" riddle is now being systematically sought at the University of Alberta. The Industrial Research Department has undertaken the work and hopes to find the way to make available the content of the "tar sand" which is of value. It hopes to go further and fit uses for it to economic conditions in the province. The attempt will be made, for instance, to demonstrate that the "tar sand" bitumen can be used in improving the highway conditions in Alberta.

### 10,000 Square Miles of Deposits

One travelling into the Northland by way of McMurray and the Athabasca River can see the "tar sands" exposed on the banks of that great waterway for a distance of more than one hundred miles. The material can also be seen in the banks of the tributary streams. Such evidence has caused geologists to conclude that the deposit must extend over an area of at least 10,000 square miles. By the action of water during some past geological age, a huge bed of sand, approximately two hundred feet in thickness, was deposited on a floor of limestone over this great area. Succeeding ages buried the sand beneath several hundred feet or more of material. But, in the meantime, petroleum from some source that the geologist has not yet determined, leaked into the sand and coated all the particles with a heavy mineral oil. The bituminized sand bed would be unknown to us to-day and safely hidden away if it were not that the Athabasca River and its tributaries had cut down their deep valley trenches through the covering to the sand and brought it to view. Most of the deposit, as a matter of fact, is hidden away under its heavy overburden and might about as well not exist, for it is only the material that is uncovered along the river valleys that is ever likely to be of any practical use.

A close examination of the "tar sand" shows it to be a dark brown to black looking material, soft enough, when fresh, and not too cold, to be deformed by the pressure of the fingers, and sticky enough to soil them with the tar. It has a decided petroleum smell. A magnifying glass enables one to see that each of the small sand grains is surrounded by a coating of the sticky oil. This oil, in a good sample, makes up about one-third the volume of the "tar sand". It represents, however, only about one-fifth of the total weight.

If the "tar sand" deposit were located in the populated part of the province, a certain amount of it could be directly utilized. Similar material occurring in certain parts of California has been long used for making pavements. There is a pavement in Edmonton built for demonstration purposes by the Dominion Department of Mines, from the McMurray deposit. The small amount of useful material in the crude product, however, is an insurmountable obstacle in the way of its transportation to any distance. Since four-fifths of the weight of the material is worthless sand it is not hard to understand that it will not take much shipping charges to bring the cost far in excess of any value it may possess.

### Separation of the Bitumen

There is only one way to utilize the "tar sands" economically. Some scheme must be devised whereby the sand and bitumen may be separated from each other at the deposit, the sand discarded, and freight paid only on the bitumen to the point where it is wanted. Many schemes to accomplish this end have been proposed, and not a few have been tried. Most of the schemes fall into one of two classes. They either aim to take the bitumen away from the sand by driving it out with heat, or else by dissolving it out by some liquid in which the bitumen is soluble. Both schemes work, but not economically. The heating, or retorting, method is faced with the necessity of heating for nothing four times the weight of sand that there is of bitumen. Further, all the bitumen cannot be driven out by heat. Quite an appreciable portion of it remains and is destroyed. The solvent method is also inconvenienced by the necessity of handling large quantities of sand, which makes it difficult to prevent loss of solvent which is a more valuable commodity than the bitumen being reclaimed from the sand.

It appears that some new lines of procedure must be thought out if the "tar sand" problem is to be solved. It is to this task that the Industrial Research Department has been set. Investigational work has been proceeding for some time now, and with considerable progress.

The research department does not, however, propose to leave the question when a separtion process has been found. This would be to only half solve the problem. It is useless to extract the bitumen if there is no use for it after it is extracted. It is a common belief that the mineral oil that is present in the "tar sand" is on a par with petroleum such as is obtained from an oil well. There is a very real difference. When petroleum is distilled, light oils such as gasoline, kerosene, etc., pass over, while the part left in the still becomes thick and heavy. The material in the "tar sand" is more like what is left of a petroleum after the distillation process. Unfortunately much of the valuable parts of the original petroleum that leaked into the sand has disappeared. The "tar sand" will be a very unimportant source of gasoline. The most of the bitumen will have to be made use of in some other way.

### Will Have Use In Road Work

The province of Alberta has one great need, and it is an idea of the research department that the "tar sands" can be made to fill it. Alberta needs serviceable rural roads, and is at a loss to know just how they are to be obtained. It is not at all improbable that the "tar sand" deposit is Nature's compensation to this province for withholding the common stone road-building materials. Alberta is a province where the earth road in some form must be the prevalent type. Soil materials must form the bulk of any road structure if the prohibitive expense of imported materials is to avoided. Alberta earth roads on the whole, are fairly satisfactory when they are dry, but when the wet weather comes, their stability vanishes. Is there any way in which the earth road can be kept as satisfactory under wet as under dry conditions. Some preliminary experiments performed in the research laboratory seem to indicate that a reasonably small percentage of the bitumen, extracted from the "tar sands", when incorporated into clayey soils, prevents them from turning soft and sticky when exposed to moisture. The bitumen mixes with little difficulty into the wet clay soil. When the soil again becomes dry, it is found that its behaviour toward water is decidedly modified. Work is under way to thoroughly investigate this effect, and to ascertain how much it can be counted upon to solve the earth road difficulties.

The Industrial Research Department believes that the "tar sands" and the earth road present phases of one big problem, and that the solution of the one involves the solution of the other. The bitumen, to be made available for economic use, must be separated from the sand with which it has been associated. At the present moment, however, it is not evident that there is any important economic use which would take care of a large production of tar-sand bitumen. The development of a method for utilizing this bitumen in the construction of an economic type of improved rural earth road seems to offer one of the best foundations for the development of a "tar sand" industry.

# Gunite Should Receive Recognition in Civic Building Codes

## The High Quality of the Product Recommends it as an Ideal Material Within Certain Limitations and Definite Provision Should be Made in By-laws for its Use

By B. C. COLLIER, Vice-president and General Manager, Cement Gun Co., Allentown, Pa.

Gunite, the product of the cement gun, has become so firmly established as a material of high quality that many cities are making definite provision in their building by-laws for the optional or enforced use of gunite under certain conditions. The writer feels that there are sound arguments back of this policy and proposes in this article to summarize them and note their significance, particularly as they might appeal to the drafters of building by-laws. The article following is, in fact, a letter slightly amended, sent by the writer to a committee that is undertaking a revision of the building code of the city of Baltimore, Md. It is published here with a view to acquainting other building departments with arguments in favor of gunite. Readers must appreciate that the wording of the article is addressed to municipal officials.

Gunite is the mortar or concrete produced by the placing of sand and cement under high pressure (pneumatic) by the use of the "Cement-Gun," a machine governed in its principles by the hydration of the material at the nozzle. This principle and pressure results in the formation of a mortar (or concrete) possessing the characteristics of very great strength, waterproofness, high acid resisting qualities, and high fire resisting qualities. I shall endeavor to treat of these various characteristics in such a manner as to show you conclusively that in allowing the use of this material for building construction in your city you will have effected economies in the building industry that cannot be obtained in any other manner.

### Strength of Gunite

Since the adoption of gunite by the engineering profession, it has been a matter of common knowledge that its strength was far in excess of ordinary poured concrete, but it was not until 1918 that this information could be so determined and tabulated as to allow for definite values. When the U. S. Shipping Board began its extensive program for the construction of concrete ships it was decided to establish a laboratory in Washington whose sole functions would be the determination of gunite characteristics, and the authorities in charge co-operated with certain officials of the Bureau of Standards, and availed themselves of the facilities of the Bureau for making these tests. As a result of a large number of samples "shot" under varying conditions, the compressive strengths, moduli of elasticity and adhesive qualities referred to in the monograph prepared by the writer (Bulletin No. 122) were deduced. The figures in this paper while appearing under my own name had the official sanction of the engineers of the U. S. Shipping Board, and were as a matter of fact, edited by them before issuance.

After the publication of this paper there was a constant demand from engineers in all quarters that these crompressive values be further confirmed by tests on thin slab sections, a form of construction for which gunite especially lends itself. As a result of this demand one of the most extensive tests on slab sections ever made was carried out under the direct personal supervision of Prof. M. O. Fuller of Lehigh University, and of Mr. George E. Strehan, a consulting engineer of New York City, who is author of the slab formulae accepted as standard by the building department of New York. The separate reports of both of these gentlemen is contained in our slab bulletin.

Attention is called to the fact that these gentlemen approached the question from opposite viewpoints and reached the same ultimate conclusions, viz, that gunite mixed in the proportion of one part cement to three parts sand (less than ¼") has a safe compressive value of 1500 pounds per sq. in. (against the 650 to 700 lbs. usually allowed for poured concrete) and that a mixture of one part cement to two and one-half parts sand produces a gunite slab with a safe compressive value of 1800 pounds per sq. in.

Attention is called in this report to the small deflections and statements regarding the methods in which the slabs failed, and it is a matter of note that all failures were due to the pulling apart of the steel in all slabs in which the area of the steel was less than one and six-tenths per cent of the area of the gunite above the neutral axis. Observation of the tables will show you the truly balanced composite slab has percentages based on this theory.

We, therefore, submit for your first consideration these compressive values, and call your attention that they also have been proven elsewhere—by tests made at the Ecole des Arts et Mercers in Paris, at the Laboratory of the Hydro Electric Power Commission in Toronto, and by engineers of one of the large ship yards in England, and request that you incorporate in your Code, clauses which will allow gunite floor and roof slabs (and other members if desired) in structures of all classes with the rating of 1500 and 1800 pounds as indicated above for safe working loads. These slabs should, however, be restricted to the following rules:

(A) The reinforcement used should be incorporated in such manner that in no case should it be closer that three quarters of an inch from the upper or lower surface of the slab.

(B) This reinforcement shall be in true planes, and shall be of such shape that the smallest opening between the strands shall not be less than one and one-half inches, and the largest space no more than four inches (unless in cases where sufficient strength shall be given to the direction of the stress against bending moment when the latter space may be as much as eight inches).

(C) All adjacent sheets of mesh shall be lapped at least three inches, and the ends of sheets shall be lapped at least six inches. All laps and joints shall be tied together.

(D) Vertical surfaces of gunite shall be applied to no greater thickness than two inches in one operation and before the application of a second layer the preceding surface shall be carefully cleaned and washed down with water and air.

### Waterproofness And Acid Resistance

While not bearing directly on the value of gunite in a building code determination of values, these two characteristics are of special interest because of the increasing discussion in all quarters regarding the question of the rusting of the steel in concrete. As noted in our Bulletin No. 122, page 13, tests were made by the University of California to determine the water resisting qualities of gunite. Other tests were made by Fritz laboratory, Lehigh University, and referred to in Bulletin No. 122, page 7. The acid resisting qualities are referred to in a letter shown on the back page of our Bulletin 114, where a tank built of gunite was subjected to 10% sulphuric acid at 200° F. for 136 continuous days before the tank broke down through failure at the corners. Samples of this tank which prove the great protection that gunite offers to steel reinforcement under such very severe conditions are extant today. These two features render gunite especially valuable not only as a protection for concrete girders and columns exposed to the atmosphere or dampness, but makes it especially advisable for steel encasement. Its use in the latter connection has been especially marked in Grand Central Station, New York City, where several million square feet of steel surface is covered with gunite, and where a great deal of concrete encasement has been removed and gunite substituted, due to the discovery that corrosion continued underneath the concrete, and that gunite prevented this. You doubtless have noted the recent failures of slab roof of the kitchen of the Marlborough Blenheim Hotel at Atlantic City, and the arch bridge aver the Miami River at Dayton, Ohio, both due to steel rusting inside the concrete encasement. (Both of these disasters have been described in the Contract Record in recent issues).

Gunite has been used in the last two years for the construction of a roof over the nitric and sulphuric acid house of the General Chemical Company at Marcus Hook, Pa. where concrete tile had failed in a very few years, and for the restoration of the concrete girders and other members of the building of the Celluloid Company of America at Newark, N. J., which the acid fumes from the vats were destroying.

### Fireproofness

This particular feature of gunite renders it of the greatest value as a method of building construction, especially when taken in connection with the previously referred to characteristics of strength and imperviousness, because the three taken as a whole result in the maximum of safety combined with the minimum of dead load weight on the structure.

Gunite was first used as a fire protection coating by the engineers of the New York Central Railroad at Grand Central Station, and then later in the Woolworth Building, New York. The official acceptance of gunite in this connection was made by the city of New York on July 3rd. 1917. Tests have, however, been carried on recently by the Underwriters' Laboratories in Chicago, and by the fire testing laboratory of Columbia University, which tests have definitely proven the claims that gunite is a fire protecting medium both for steel encasement, and for partition and exterior walls. Reports on these tests are now being prepared.

You are doubtless cognizant of the determination made by the Underwriters' Laboratories to the effect that unprotected steel has a life, when under fire conditions and when subjected to its designed load, of only ten minutes. You are also acquainted with the report of the fire committee of the Concrete Institute which recommends that the exterior of all concrete girders and columns shall be covered with at least one inch of cement mortar as a protection against fire. It will, therefore, be desirable to recommend that all buildings will have the steel and concrete protected. In this connection the test at Columbia University will be of great value to you. Three slabs supported by 12" steel girders, 14" clear span, were subjected to 1700 deg. F. for 3 hours. The girders were protected. with one and one-half inches of gunite made of one part cement and ten parts cinders (less than¼") reinforced with "Steelcrete" expanded metal of 2" mesh and 16 gauge. The slabs were respectively 6' 3" span, 1-½" thick, reinforced with 2-¼"-9-.30 expanded metal, with a live load of 40 pounds per square foot; a 6' 10" span, 2-¼" thick, reinforced with 2-¼"-6-.40 expanded metal, with a live load of 150 pounds per square foot; and an 8' 6" span, 2-3/4" thick, reinforced with 2-¼"-6-.40 expanded metal, with a live load of 150 pounds per square foot. At the end of three hours the 8' 6" span failed by a hole about 24" diameter breaking through, due evidently to the excessive heat on the steel stressed to 20,000 pounds per square inch in the slab of such great span. The remaining two slabs were loaded the following day to 200 pounds per square foot and 600 pounds per square foot respectively without destroying or without affecting the supporting girders other than to slightly increase the deflection. None of the protecting gunite on the girders was broken off.

These tests showed clearly the advantages offered by the use of gunite slabs, as their strength and fireproofness is especially marked in comparison to concrete or other materials and the thinner floor or roof slab sections made possible by the use of gunite result in great economies by reducing the dead load on the structures.

The tests made at the Underwriters' Laboratories have been on vertical walls. The recent decision of the committee appointed by Secretary Hoover, of which Mr. Ira H. Woolson is chairman, has formulated a rule for governing the standardization of different types of walls which is about as follows:

A wall shall have a rated fire resisting period equal to 80% of the time during which it resists the transmission of heat from the standard 1700° F. to 2100° F. on the exposed side, to 300° F. on the unexposed side, it being assumed that the wall shall have successfully resisted the passage of flames, as well as having resisted calcination due to heat, or the application of a stream of cold water under pressure against the heated surface.

One wall at Chicago successfully withstood heat up to 2100° F. for 4½ hours; and the other 1700° F. for one hour, and water at 60 pounds pressure for ten minutes; without breaking down or allowing the passage of flames. No tests were made on heat transmission of 2" slabs at that time, and consequently accurate measurements were made of this at Columbia, where it was found that the 1-½" slab did not show 300° until 101 minutes had elapsed, and the 2-¼" slab showed 300° at 110 minutes. Eighty per cent of this time would mean an allowance for the 1-½" slab of 80 minutes, and of 88 minutes for the 2-¼" slab.

The principal test at Chicago was on a fire wall consisting of two 2" reinforced gunite walls spaced eight inches apart and connected at about six foot centers with a connecting 6" x 8" reinforced gunite stud shot monolithically with the walls. This created a wall with a dead air cell about 6' x 8" x the heighth of the panel, and the preliminary report issued by the late Mr. W. C. Robinson, vice-president and chief engineer of the Underwriters' Laboratories, characterized this wall as being better than 12" brick walls in resistance to impact, and equivalent to them in heat resistance. The salvage value of this wall is perhaps greater. It will, therefore, be apparent to you that if your code allows the use of such a wall for the exterior walls of first-class buildings, the saving in dead weight effected will result in great economies to the builders of your city, and at the same time secure fire resisting results of the highest value.

It will also be apparent that the use of 2" partition walls, or walls of similar thickness for stair or elevator walls, will result in similar benefits. If such allowances are made, specifications governing the attachment of the walls to the supporting member should be rigid, and provide that no stud or supporting member should be spaced closer than four feet apart and no greater than seven feet.

## Building Costs Increased by Action of the Unions

Continued from page 1100

that there is more work than can be done by the men on hand. The result is that you can find bricklayers smoking cigars on the job. The employer does not dare sack them.

"A general complaint is that the unions close their books and limit the number of apprentices. A man cannot become an apprentice plasterer after the age of 19. That is as bad a restriction as I know in any industry. The shop stewards make marks on the windows and say the men may do so much work in a day.

"The bricklayers do not allow the employer to engage laborers to wash down buildings. They say that is their work. There is a difference of $3 a day in the wages of a bricklayer and a laborer.

"The contractor who put up the building for the Pictorial Review on Seventh Avenue put paving blocks in the floor. Pavers got $2 or $3 a day less than bricklayers. but the bricklayers insisted on getting the job, although the blocks are wooden blocks. They got the job, but no builder in New York has put in paving blocks since then.

### Sees Unionism Imperilled

"I am a believer in trade unionism. but I say that the destruction of unionism in this country will come if the unions continue to bar out men and at the same time insist on employers hiring none but union men. If the doors are thrown open to membership the situation will right itself.

"The hoisting engineers have closed their books for some time to new applicants. All their members

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# British Columbia Lumber Finding Readier Market in Eastern Canada

## Imported Timbers are in Less Demand as the Value of Fir and Other Western Woods is being Realized—Building By-Laws Slow in Recognizing Superiorities of Douglas Fir

By L. L. BROWN,
British Columbia Lnmber Commissioner, Toronto.

IT is the purpose of this paper to show something of the potential market existing for B. C. woods in Eastern Canada; of the work which has been done in introducing our woods there, and to suggest a more effective medium for reaching the ultimate consumer, in the shape of the home builder especially, in the large centres.

Increases in sales of British Columbia woods in Eastern Canada will be due to the following reasons:

1. An increase in the lumber consumption of that territory.
2. A decrease in the lumber production of the East and of the imports of foreign lumber.
3. An increase of the popularity of our woods—which will be used as substitutes for more expensive woods.

I intend to pass over the first two points asit is well known that the population and industrial size of Eastern Canada is growing apace and that the supplies of the more important Eastern Canadian woods are becoming rapidly depleted—as, for example, the exhaustion of eastern cedar for the manufacture of the famous Peterboro canoe, the canvass and strip models. Clear white pine is now almost impossible to obtain in Ontario. The supply of oak is rapidly decreasing in Canada, and the major part of the chestnut used in Canada is imported from the United States.

Under the third point, however—the popularizing of our product—a great deal can be said, and it is this work which the Forestry Branch of the Provincial Department of Lands is concentrating on. We realize that we cannot afford to wait for the inevitable day when the East will be compelled to use our woods. This educational work must be done with the wholesale and retail lumberman, the wood using concerns, and the ultimate consumer in the shape of the home builder. A great deal of work has been done with the wholesale and retail lumberman by the British Columbia mill representatives. The older two classes, however, the wood-using industry and the builder, have been to a great extent neglected.

The annual consumption of soft woods by the wood-using industries of Eastern Canada is approximately 763 million feet, exclusive of pulpwood. Practically half of this amount is used in the Province of Ontario.

In order to properly put the merits of our woods before the large industrial concerns of the eastern markets a detailed knowledge of the use to which the wood is to be put must be obtained. This can only be obtained by detailed study in each particular factory. In introducing our woods to these factories, we speak in terms of tensile stress and moduli of rupture and elasticity, for many of these large concerns maintain their own laboratories and trained engineering staffs. In this connection it may be interesting to relate some work which has been carried on in connection with the engineers of one of the large implement manufacturing concerns in Ontario. They had been for years very large users of southern pine pole stock, i.e., poles for binders, etc., and although they had at times used some fir—when I approached them they had definitely determined to discontinue its use and had given orders to their purchasing agent to stop buying it—this because they had decided that southern pine was stronger than fir and that their waste in using the pine was less. I found that they had no definite data in regard to either matter, and on approaching the general manager, he placed the experimental laboratories, together with an engineer, at my disposal, and stated that if I could prove my contentions they would adopt our product. They undertook to run some pine and fir poles through the factory, and we watched different lots of these through the plant, noting the lumber culled during each operation, together with the reason therefor. I found that they were having greater losses on the fir, due mainly to scant sizes—that oft repeated criticism of our product—and also to the presence of cross-grained blanks. Both of these defects could easily have been taken care of at the mill. It has been proved by strength tests that a beam containing spiral grain with a slope of 1 in 15 shows a decrease in the amount of work to maximum load of 35% as compared with a straight-grained stick. The fault, then of considerable waste—in some cases as high as 25%—could easily have been avoided by a proper inspection at the point of shipment. Besides the question of greater waste in fir there was to be considered the point of strength. To determine this the plant engineer selected pine poles while I selected fir poles from one representative lot as they went through the factory. These were securely held at one end as in service and loaded at the other end to failure. These tests proved that the fir on the market today averages more that 10% stronger than the same grade of southern pine, and what is very important, the fir is of a much more uniform grade.

There are a great many people who do not realize the superior merits of Douglas fir. If I told you that Douglas fir will support a greater dead load as a post or as a beam than red oak, and that it is at the same time more endurable, I dare say you would be surprised, and yet such is a fact. While studying the manufacture of railroad cars in the car shops of an Eastern railway recently I found they were using large quantities of American red oak. Subsequently I mentioned this to the master car builder and asked him why he was importing red oak for car framing when he could buy British Columbia fir, a stronger wood, at a considerable saving. The upshot of it all was that we were soon on the way to the Forestry Laboratories at McGill University to try out the truth of my contentions. Fir emerged victorious from the tests, with the result that it has now been adopted as standard by that railway. That railway alone imported over two million feet of red oak the preceding year, at a cost of more than $160,000

The railway officials were very much surprised at the strength of Douglas fir, and would never have changed from oak to fir if they had not seen the actual tests. This result could only have been accomplished by actual field work. Through our efforts this railway has also adopted Western hemlock as standard car siding and box car door framing, and is trying British Columbia mountain larch for car decking. The increase of our markets for hemlock is recognized as a vital necessity in order that it may be economically logged along with the other species with which it is found. It is rather unfortunate that this admirable wood was ever so named, on account of its Eastern relative of ill repute. However it is being sold by putting the accent on the Western part of its name , and in some cases under the alias of grey fir, etc., and when once used is proving very popular. I have talked to a number of retailers who prefer it to fir, claiming that it works better and has not such a distinct grain.

A month or so ago I learned on visiting a factory in Ontario they were using Douglas fir staves for hand and power washing machine staves in place of southern cypress, and what is more, after considerable experience and tests of the tubs in service, pronounced the fir superior. Only the one factory of four large ones in Ontario was using fir—now all of them are experimenting with it and I have every reason to hope will adopt it as standard. There are approximately 30,000 tubs made in Canada per year, consuming two million feet—all of which has heretofore been bought in the United States.

### Correcting Building By-Laws

Implement manufacturers present a very large field for the extension of our markets. One Ontario firm used approximately 2 3/4 million feet of southern pine last year. I hope to carry out tests in several plants in the near future comparing the merits of southern pine and fir. No mere matter of sentiment will effect a change in this connection, but we must show fir to have superior qualities at, at least, an even price. Another important branch of the work to be done is that in connection with existing building by-laws, which define just what strength factor shall be used in computing the sizes of members used. Recently one of the largest cities in Eastern Canada issued a building by-law showing the strength of southern pine as approximately 50% greater than Douglas fir. This was manifestly unfair, and was corrected after authoritative information was produced.

At this point it may be interesting to note the magnitude of the requirements of the railways, the largest wood-consuming industry in Canada. Their requirements come under the three main heads of ties, bridge and building, and car material.

The annual lumber requirements of Canadian railways are difficult to obtain. It may be interesting to note, however, that last year a railroad with 13% of the mileage in Canada purchased nearly 28 million feet of softwood lumber exclusive of ties, and that in the province of Ontario alone approximately 25 million feet were used in the construction and repair of railway cars. The latest official data available shows more than 111 million feet per year of lumber used in Eastern Canada in the manufacture and repair of railway cars. Some of the largest railways are at present using only B. C. woods in the construction of box cars with the single exception of one piece of oak at each end to absorb the shock of impact. Of the ties purchased—approximately 645 million feet per year—very few of those required for the eastern lines have been of British Columbia woods. The Western lines, however, have used very large quantities of our woods for this purpose. Of the bridge and building material a very large proportion has been British Columbia material, and here it is gratifying to note that practically no yellow pine is being brought into Canada by the railway companies themselves, although there are several millions of feet annually being imported by car-building companies.

### Car Construction

In the manufacture of railway box cars Douglas fir has proven to be the wood par excellence. The supporting sills demand long, clear timber of the greatest strength and stiffness, the decking must present a hard-wearing surface, the sheathing and roof boards must take paint well and be inherently durable. All of these properties are found in Douglas fir. Notwithstanding the advances which steel and concrete and other substitutes have made, it has been found that wood is still the superior material for many uses. In railway car construction, especially, this has been found to be the case. It seems to be the censensus of opinion that the very best box car yet designed is the steel frame car with wood sheathing, flooring or decking and roof. These cars are lighter to haul, a very important item, and are much more easily repaired. Another interesting fact is that it has been found by one eastern railway that coal cars with wooden sides last longer than the all-steel car, as the chemicals in the coal corrode the steel and bottoms, destroying them completely in about ten years. It has also been found that a wooden roof covered with canvas gives longer service and is more economical than steel roofs for passenger and baggage cars.

### Douglas Fir in Building Operations

The University of Toronto provides a number of outstanding examples of the use of several British Columbia woods in recent construction. Red cedar has been used with excellent effect in the Tudor ceiling of the music room of the Hart House—a magnificent $2,000,000 building designed by Sproat and Rolph, of Toronto. These architects are also using this wood in the roof of a memorial hall being erected at Ridley College, St. Catharines. The electrical building at Toronto University recently completed, was finished in Sitka spruce, and the Anatomy Building under construction, and Trinity College to be started soon, are to be finished in British Columbia fir. It is also gratifying to be able to state that although last year the City of Toronto's Board of Education were using large quantities of southern pine, they have now standardized on Douglas fir, and that in the two million dollars' worth of work in this year's scheme of building, Douglas fir alone is specified for doors and trim. Douglas fir is fast becoming standard for school trim and doors all over Ontario, It is interesting to note that in border cities of Ontario practically all interior trim is either Douglas fir or southern pine, whereas in Toronto, for example, there is a small percentage of any trim used other than oak or chestnut, the major part of both of which woods are imported. A wonderful opportunity awaits the proper advertising of British Columbia woods for doors and trim in the City of Toronto, which is bound to see a great building boom, especially of small residences, in the next few years. Only 2,175 dwellings and two apartment houses were built in that city in the first eight months of this year, in contrast to 4,586 houses built during the year preceding the war. It estimated that Toronto should build dwellings at three times the present rate for the next five years at least.

### Creating a Demand for B. C. Lumber

The introduction of our woods cannot be left with the average retailer, many of whom have interests in mills cutting other woods, and the remainder of whom are not vitally interested in our progress. To my mind the British Columbia manufacturer cannot afford to wait for the eastern retailer to popularize his product. The manufacturer must create a demand for his product in the breast of the ultimate consumer. The manufacturers of those products most intelligently marketed in this country today appeal direct to the consumer, and do not depend on the retailer entirely to push their product, although they do maintain a very real and helpful co-operation with him. The manufacturers of substitute shingles provide a very striking example of this. They not only maintain a close co-operation with the retailer by providing him with dealers' helps and advertising hints and cuts, but also by direct appeal to the consumer through advertising in newspapers, farm journals, exhibitions at local fairs, and most important, by personal calls of their own representatives. I daresay there is scarcely a house built in a city in Ontario today but what a representative of substitute shingles calls and puts forth the merits of his product, to say nothing of what he does to British Columbia shingles. With such a one-sided proposition it is easy to imagine why one sees so many substitute roofs in that territory. It is a most remarkable fact that the substitute shingle people are succeeding in selling an inferior article for more money. The total output of the prepared roofing manufactured in Canada last year was valued at more than 8¼ million dollars, approximately two-thirds the value of the British Columbia shingle output. I know of no more striking example of the result of modern advertising and selling industry.

It is the necessity of such advertising which I would impress on the timber industry of British Columbia. I submit that this advertising should not take the form so much of newspaper and magazine advertising as of personal field work; that a staff of several men could be advantageously employed in the East, that in such a centre as Toronto at least one man could be advantageously employed calling on every builder and prospective builder, putting before him the merits of British Columbia lumber and shingles, and that a much larger and more detailed exhibit than the present one should be maintained in Toronto. This exhibit should be composed of different rooms such as a living room, dining room, kitchen, etc., finished in British Columbia woods and completely furnished. How much more productive of results such a display would be than a collection of stained and varnished boards. It is very difficult for a prospective builder to visualize the effects obtainable with our woods by looking at a piece of 1 x 6 board, or a section of wall panelling. The idea of home carries a very strong appeal to every being, and I submit that an exhibit containing several rooms finished in our woods and properly furnished will do more to popularize our product than any other media, and at the same time go far to create a demand for homes. In the creation of this demand the manufacturer will at once be performing a service to himself and a very great benefit to the nation.

# How to Select, Install and Operate a Concrete Mixer

## The Whole Concreting Plant Problem Discussed—Types of Machines and Their Purpose—Labor-Saving Accessories—Care of Equipment

From "Public Works"

Most experienced operators have one or more favorite makes of mixer, which are often replaced by duplicate orders whenever any of them are worn out or additional ones are needed. It does not, however, follow that the selections, often made casually at first, are the wisest. It would be well for all contractors to pay careful attention to the subject, determine what are the best sizes and makes of mixer for them to use, and why they should be used and govern themselves accordingly in future purchases of equipment. In this way they can, without extra cost, make their plants conform to a fixed policy and have their machines ultimately standardized and duplicated to secure the highest efficiency and economy, matters of importance to contractors commencing to accumulate equipment and gain construction experience and reputation.

Although it is possible to mix concrete well by hand, it is generally discouraged and often prohibited by specifications, except in very small quantities or in isolated positions where the installation of a machine would be very difficult or expensive. The facts that the work can be done much more rapidly efficiently and continuously by a machine and at a unit cost greatly below that of hand work, and that the use of the machine eliminates a large amount of sometimes unreliable hand labor, make a mixer the first requirement of every contractor. A concrete mixer can be used, not only to mix concrete, but various other substances, especially mortar. These machines or modifications of them are also successfully used for mixing plaster, fertilizer, and various other materials.

### Types of Concrete Mixers

For their fullest efficiency continuous mixing machines should be equipped with large storage for cement, aggregate and water and reliable automatic measuring and delivering service and abundant facilities for continuous distribution of the finished concrete. In case of necessity these machines can, of course, be operated intermittently and have separate measured quantities of materials passed through them as in an ordinary batch machine, but such operation eliminates the special advantages the machine is designed to secure without giving those specific to the batch machine. An early type of this machine, now seldom used, consisted simply of a long open trough, with concentric revolving shaft having radial arms or blades, pitched to move the material from one end of the trough to the other somewhat after the principle of a worm conveyor.

Another continuous machine of very simple construction, that could be made by ordinary mechanics, consists simply of a long vertical or steeply inclined chute or tube provided with interior baffle plates, projecting arms or their equivalent. The materials being emptied into a hopper at the top of the mixer fall by gravity to the bottom and in transit are thrown from side to side and more or less thoroughly mixed in their descent.

Another type of gravity machine that, although used as a batch machine, might be uninterruptedly supplied with measured quantities of materials and operated as a continuous machine is the multiple hopper machine, in which a series of hoppers are vertically super-imposed and the materials falling from one pyramidal or conical hopper into the one below are more or less completely turned over in the descent and are mixed wholly by the transverse motion and rolling effect of the downward and sideways progress of the heavy charge moving wholly by gravity. It is claimed that it is turned over in passing through each of the three or four hoppers to the receiving hopper below.

These machines are simple in construction and can be built of any required dimensions, but like other gravity machines, cannot provide for any variation or modification in the manner or duration of the mixing. All gravity machines are obviously subject to the universal law that it is impossible to get something for nothing and as the efficiency of mixing must correspond in at least a minimum expenditure of power in the mechanical operation, it must require a certain considerable height of fall and very efficient turning over appliances to equal the rolling and pitching and kneading effect of power machines.

### Revolving Machines

Batch machines are mostly of the revolving type, and constitute a very large proportion of all machines used in this country. They generally have a capacity of from ¼ cubic yard up to a maximum of 4 or 5 yards. They receive a premeasured quantity of materials and, unless cubical, are equipped with fixed or moveable interior blades, projecting from the inner surface of the drum that are so arranged as to lift and shift and drop the aggregate as the drum revolves, producing a rolling and even kneading action that is very efficient and usually suffices for a satisfactory mixture after 10 or more revolutions of the drum occupying from ½ a minute to 2 minutes according to requirements, the average time being about 1 minute of actual mixing. In some types the machine is both charged and discharged while in revolution and in others, as in the cube, it must be stopped to receive the material and discharge the concrete.

For several years efforts have been made to mix concrete by the forces provided for its transportation, especially when the aggregate is stored and measured at a distance from where the concrete is placed. There is now on the market a machine, mounted on an auto truck and operated by the regular engine of the latter, that is charged by gravity from elevated bins, mixes the concrete in transit, preferably at the end of the route, and discharges by gravity through a chute that may be moved by the truck as it delivers so as to speed the concrete.

### Pneumatic Mixers

Within a few years considerable attention has been devoted by prominent manufacturers to the development of pneumatic mixing machines in which the concrete shall be mixed by the operation of jets of compressed air in a closed chamber. These have been usually operated in connection with pneumatic conveying apparatus, by which the mixed concrete is forced through a 4 to 8-inch pipe to the required position in the forms. Both operations require a considerable amount of compressed air and therefore involve a compressor plant that is expensive to install and operate for mixing purposes alone, so that the pneumatic mixer is usually best adapted to situations in which there is very little working room and it is important to avoid obstructions, as particularly in small tunnels.

For general purposes the revolving type of batch machine is satisfactory and several makers have developed it to a high degree of efficiency and economy, but the other types have been useful and will be useful when conditions make them more convenient or are especially suited to their peculiar features.

### Selection of Mixer

Unless it is required for a job of such great magnitude or duration that its execution outweighs all other consideration, the concrete mixer should be selected with a view to its future use on the character of work that the contractor is likely to undertake thereafter. In any event the machines should be simple, efficient, powerful and durable, of high class materials and workmanship and easily operated. It should be of simple and sturdy construction and easily assembled, and should be supplied with spare parts of any sort that may be especialy likely to failure or rapid wear so that they can be replaced with the minimum cost and delay if necessary, but in a first-class machine such replacements are rare and with good care the machine will operate for a long time without danger of breakdown.

It is, however, advisable that the machines should be all of one standard make and if possible of only one or two sizes, so that a few spare parts may serve for the entire equipment and that the operators soon become thoroughly familiar with the machines and their requirements and are not confused by shifting from one machine to another.

It is also important that the machines be fitted for operation with steam, gasoline or electric power as may be most desirable, and at present the gasoline motors are likely to be most convenient and economical in a majority of small or moderate size jobs.

The tendency at the present time is strongly toward the use of multiple units of small capacity rather than of very large machines, and the extremely small machines down to a capacity of ¼-cubic yard per batch are increasingly popular, although a great many machines of ¾-yard capacity are in use. For special work where a very large amount of concrete is to be placed in one mass, as for instance in huge ship canal locks, great foundations or enormous dams where provision is made for handling the concrete continuously through chutes or in large conveying apparatus, one or more especially large machines are sometimes installed.

Ordinarily, however, a number of small machines is better for various reasons. They are carried in stock and can be quickly purchased and delivered. They are very much lighter and freight charges are less. They are more easily handled, transported and installed. They require no costly foundations and can be set on their oyn trucks or on timber sills. The use of a battery of mixers is substantially equivalent to maintaining reserve equipment, since only one of a number of mixers is thrown out of service and the rest may continue in operation while the one is repaired. They are far more flexible and can be shifted from point to point on the job or when the bulk of the work is done a part of them can be moved and put on other work; they can be easily moved so as to receive aggregate directly as it is brought to the site. They are more saleable at the close of the job and have a higher cash value than large machines.

### Moveable Mixing Plants

The smallest size machines are frequently mounted on wheels so that they can be easily moved by hand for moderate distances over level ground. They may also be placed on skids that serve not only to shift them from place to place, but answer as settings for them while in operation.

For special purposes a small machine has been mounted on a motor truck equipped with storage for cement, water and aggregate for a few yards of concrete and is thus quickly available for operations at any remote place or for immediate repair or urgent service of any kind, carrying all of the necessary equipment for doing a small job with a crew of men that accompany the trucks and are not required to wait for delivery of machinery or material. In case the job requires more concrete than the supply from the storage on the trucks the quantity can easily be doubled or trebled by hauling it on a trailer or by a service truck provided for the special purpose.

Whenever a considerable amount of work is done on the waterfront it is generally desirable to install the mixer or mixers on one or more barges that can easily be fitted with loading, unloading and hoisting apparatus, and very readily shifted from point to point with only a few feet at once to keep within the most convenient distance of the work in order to deliver the concrete directly to it by derricks or by spouting. The barge may have storage for a considerable amount of cement and aggregate, but is frequently provided only with small service hoppers that are filled from a material scow alongside, which can be replaced as often as necessary and enable the small hoppers to always provide immediately supplies by gravity to the mixers.

Similarly traveling plants may be installed on shore and have a platform on which the mixer is set with service storage bins alongside and usually the derrick to maintain the latter filled with aggregate, the whole equipment being easily moved on a broad gauge track as required. An equivalent of arrangement is provided by the installation of the mixer, storage bins and loading and unloading apparatus on a railroad car that may be supplied with aggregate from tenders brought alongside or in the same train with it and served by hand or power.

### Charging the Mixer

Large mixers are generally permanently established, at least during the duration of a job, on a concrete or heavy timber foundation and receive the cement and aggregate through the fixed charging hopper into which the materials are delivered by batch boxes or, preferably, by gravity through chutes from storage bins. The cement being sometimes added in the same manner or emptied by hand from bags into the charging hopper on top of the aggregate.

Smaller machines are generally equipped either with a loading platform or a power loader. The price of the machine with the loader equipment used to be 35 or 40 per cent less than that with the power loader. While the use of the power loader on the other hand increases the output of the machine from 20 to 30 per cent and may generally be considered more efficient and economical than the platform loader for an output of 50 yards or more daily. Either type of machine can be served by wheelbarrows, hand carts, trucks, batch boxes, or by batch boxes or buckets handled by a derrick or other hoisting apparatus. The use of the platform makes more handwork and increases the probability of lost time and obstruction that is expensive and reduces the output of the machine.

When the power loader is used the aggregate is dumped into it from the ground level and there is plenty of space for its delivery and the removal of the empty containers without delaying the work.

The importance in having the machines so arranged as to maintain a constant operation is very great and is greater the larger the proportion of hand work involved or of expensive equipment used for serving it. The probability of lost time, delay and obstruction for a small machine is much less than for a large one.

### Time Schedule

For instance, a 1-bag machine will require about 5 wheelbarrow loads of cement, sand and broken stone for each charge and if this is wheeled to the loading platform to make delivery it will take at least 35 seconds, which, plus a minimum net mixing time of 30 seconds and 10 seconds for discharge, makes a total of 75 seconds minimum for 7 cubic feet of concrete. If the same machine has a power loader it may be filled and elevated while the concrete is being mixed thus cutting the time nearly 50 per cent and almost doubling the output of the machine. With larger machines the advantage of the power loading is still greater because there is more danger of obstruction of the hand loading.

### Wheelbarrow Charging

When the mixer is charged by wheelbarrows great care should be taken to arrange the relative position of the different materials, the mixer, and the finished concrete delivery, so that no operation will obstruct any other operation and that all of them may go on in a regular continuous cycle. Each man should be trained to perform a single duty with the fewest possible motions and to keep in time with the rest. and if any part of the work is exceptionally severe the men should take turns in performing it for a short time, and then be succeeded by other men, and so on. A competent foreman should be constantly in attendance watching all the operations and providing an immediate remedy, if there is any sign of congestion, or delay and replacing a clumsy or inefficient man or a broken wheelbarrow without delay.

The most advantageous arrangement is to have the sand and broken stone supplies on opposite sides of the mixer and at a slight elevation above the charging platform and to establish a loop connecting them and the machine, allowing the sand and gravel and stone to be taken alternately to the machine, dumped and the wheelbarow passed on to the other storage pile, reload and come back and so on, thus making no empty trips, and never turning around or delaying at the machine. If this is impracticable the wheelbarrows should pass continuously over the platform, leaving it on the opposite side to their entrance and not obstructing by turning around or passing.

### Capacity

When properly installed and operated a mixer of ½-yard capacity is generally ample for mixing 1,000 yards of concrete or for an output of 150 yards or less for each 8-hour shift. For special cases or very large work the number or size of the machines or both should be increased. Great care should always be taken to arrange for the maximum efficiency of the machine by removing the concrete as rapidly as it is mixed.

For large quantities of concrete it usually pays to provide elevated storage so that the mixer can be charged by gravity, an operation which only takes a few seconds and enables the machine to be run at a maximum speed of nearly or quite one batch per minute.

### Accurate Proportioning

It is of great importance that the proportion of aggregate and cement and water should be correct and that the mixing should be thorough and sufficiently continued, but unduly prolonging it is of no material advantage. These features are usually looked after by the engineer or his inspector, who should be earnestly and conscientiously supplemented by the contractor and his foreman, who will never derive any ultimate profit by attempts to skin the mixture, to curtail the time of mixing, to make it too wet or in case of cost-plus work to add too great proportion of cement.

If the job is one in which the contractor is reponsible for proportions and qualities he should take special pains to secure uniform and properly graded aggregate and, if necessary, to mix it in order to get maximum density of output, which may require changing the mixture from time to time if the quality of his materials varies. The amount of water required is also likely to vary with differences in the aggregate and even with weather conditions and should be carefully watched and regulated.

### Automatic Devices

The water should be admitted to the mixer through some sort of automatic device of which many are manufactured and others can easily be installed by the contractor with home-made appliances. The principal requirements are to have tanks that can be filled with accuracy to any given measurement while the concrete is being mixed and can be very rapidly discharged when the aggregate is placed in the mixer. The filling of the water tanks can be easily accomplished by an ordinary float valve, ball cock or overflow, and the water can be discharged into the mixer either by tilting mechanism or generally by any kind of a quick opening valve.

In order to secure a prescribed amount of mixing there has been placed on the market a mixer meter, which when attached to the driving gear of the machine and properly adjusted and sealed, counts the number of revolutions of the drum and locks the gear so that the drum cannot be stopped or the concrete discharged until after the prescribed number of revolutions have been made, notice of which is given by a gong or other signal. These meters are available on the market, and an ingenious contractor or his mechanic can easily prepare a homemade device that will register the number of turns or will at least sound the alarm after a certain number of revolutions have been made. Such an apparatus is well worth while, both for the engineer and the contractor. Various more or less obvious devices besides boxes, have been successfully used for rapid and even automatic measurement of sand, stone and cement. Usually they are arranged in connection with delivery by gravity from hopper to mixer. A simple and effective one is substantially two horizontal sliding gates set far enough apart in a vertical chute to enclose between them the required volume for one batch and both are connnected to the same operating lever that one is always open when the other is closed.

### Removal of the Mixed Concrete

All of the pains taken to select, install and operate the mixer will be of little avail if arrangements are not made for removing the concrete as rapidly as it is needed or as it can be delivered by the machine. This is done most positively and continuously when the machine can be placed at such an elevation that it delivers directly into a chute through which it is spouted to the required position, the lower part of the chute or if necessary all of it being moveable so as to distribute the concrete as required. This is often available in pit, trench and foundation work, in sewer work and the like. For work above ground level approximately similar results can be obtained by the use of a hoisting tower and spouting by which the concrete can be lifted to a maximum height of 200 or 300 feet and delivered to any point within a radius as large or larger than the elevation above the point of delivery.

Large quantities of concrete can also be handled by delivering it directly from the mixer to side or end dump cars on an industrial track high enough to enable them to dump directly into the forms and arranged so as to return on a loop and always have an empty car ready to receive the concrete as soon as a loaded car is moved away.

If circumstances do not permit the cars to place the concrete in the forms, flat cars may be used carrying 1, 2, 3, or 4 buckets, and the latter may be removed from the cars and swung to position and dumped as required by derricks, cableways, locomotive cranes or their equivalent. The mixer may also be served, as is often the case on smaller jobs, directly by the same derrick that handles the concrete buckets to position, returns them and often, at intervals, is able to fill the charging bin or handle aggregate directly to the charging hopper providing the amount of concrete is comparatively small, so that one derrick can even unload cars, reclaim from storage, fill overhead bin and directly supply the mixer.

Ordinarily, however, if the job is of considerable size, a special derrick with clam shell buckets required for unloading cars, loading the service bin or handling direct to the charging hopper, and another derrick will be kept busy handling the buckets of concrete. A cableway may also be arranged to handle either aggregate or concrete, or both.

### Belt Conveyors

For very large and important pieces of work belt conveyors are sometimes frequently installed to handle the aggregate during the unloading, storage and reloading processes and to deliver it to the service hopper. They, of course, require to be loaded at the initial point and have a tremendous capacity when kept continuously in operation at full speed, but are costly to install and are not as flexible as a railroad or derrick system. Belt conveyors have also been used on rare occasion for delivering concrete from the mixer to the forms. Their capacity is almost unlimited, but they are not available for as many other purposes as are derricks and industrial tracks and cars.

Concrete should not be delivered in large quantities or to great distances by wheelbarrows and carts or trucks, which are meant for very small work or under special conditions or in case conditions warrant the establishment of a central storage and mixing plant from which concrete can be distributed to constantly shifting points at a considerable distance by motor trucks. In this case special pains must be taken to insure the prompt delivery of the concrete and to see that it does not suffer segregation from the vibration and shaking in transportation.

### Highway Concreting

The use of concrete for the use of foundations and for the wearing surface of city and town pavements and rural highways as well, has, in a very few years become widespread and important; many hundreds of miles of such work have been constructed and hundreds more are to be built as fast as possible, and millions of dollars are at this time available for such work that is strongly urged to give relief to unemployment and stimulate general construction.

It is entirely possible to accomplish this work with ordinary concrete mixing machines, but much better economy and greater rapidity is attained by the use of special paving machines that have been very rapidly developed for this purpose and are large, self contained locomotive machines of high efficiency. They are now to be had mounted on traction wheels or caterpillar traction so as to move over the subgrade from place to place under their own power and are provided with power loaders operated by the mixer engine, and with a distributing boom or chute and travelling bucket that deposit the concrete approximately in position as the mixer advances. These machines are provided with small derrick booms competent to unload batch boxes and deposit them in the elevating hopper with which the drum is charged the moment the mixed concrete is delivered to the bucket. One of the machines properly handled will build several miles of 18-foot highway in one season and when worked to its capacity is a very satisfactory investment for the contractor, especially if he has many miles of road to build, a condition that is more and more favored by the authorities letting the work.

### Care of the Machine

A concrete mixer is usually subjected to about the most severe service of any kind of contractors' plant, and most of the standard makes are so sturdy that with occasional cleaning and faithful oiling they endure for months or even years, with very little repairs. Occasionally a gear may break or the ring on which the drum is supported may become worn or injured, but it is only necessary to keep new parts in reserve and carefully follow the maker's simple instructions to maintain the machine in good working order with little or no expense. Care should always be taken to wash the machine thoroughly at the close of work for the day to prevent any of the concrete from setting in the drum and to keep the exterior of the machine and buckets and chute thoroughly clean at all times when not in service.

Sometimes difficulty is experienced with the machine slopping or it may not always discharge rapidly and completely, but these troubles are likely to be due to the consistency or proportion of the concrete or to the speed of operation, and can generally be quickly remedied by intelligent adjustment or, at the worst, by appealing to the manufacturer, who is always ready to prescribe for a sick machine or to instruct the contractor or his forces in the case and operations so as to secure the best results.

Given enough work to do and reasonable care and intelligence in selecting, installing and operating the machine so that there is a minimum of waste of time, labor and material, a concrete mixer can hardly fail to be as profitable and satisfactory as it is indispensable to a general contractor.

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## Building Costs Increased by Action of Unions

(Concluded from page 1110)

are over 50 years of age and no attempt is made to get new members

"When the alterations to a building are to cost more than $5,000 an engineer is required to run the house elevator. That is unnecessary and expensive."

Joseph E. Donohue, delegate of the Portable Hoisting Engineers' Union was examined and said that the membership of the union at the present time is 326, that ten years ago the membership was between 300 and 350. He admitted that as building requirements increased the membership of his union decreased slightly. He denied that the union had not taken new members in years and declared that in the last year and a half the union had added from twenty-five to fifty to its membership list. The hoisting engineers are paid $10 a day.

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### Incorporation

Williams Engineering Company, Limited, with head office at Winnipeg, capital $50,000, to carry on a general contracting and engineering business.

### Drop in Cement in Toronto

**Building supplies prices, in general, remain practically the same this week, the only changes worthy of mention being a further drop of 25 cents per bbl. on cement, in car load lots, bringing the price down to $3.90, and an increase in the price of plain red oak flooring from $125.00 to $140.00 per M. The drop in the price of cement does not take effect on orders for less than car lots.**

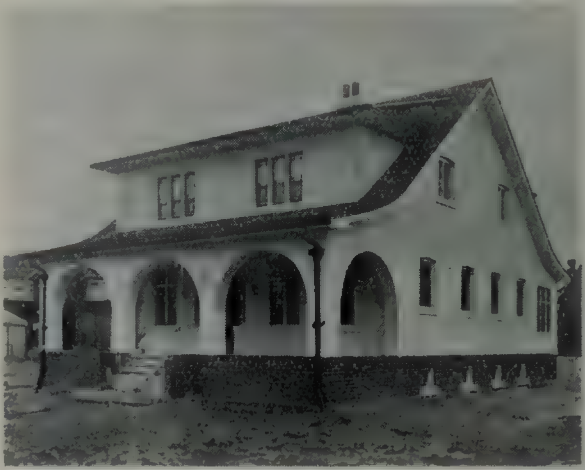
# A House Plan Suggestion

## *One of a Series of Designs Presented From Time to Time in the Contract Record*

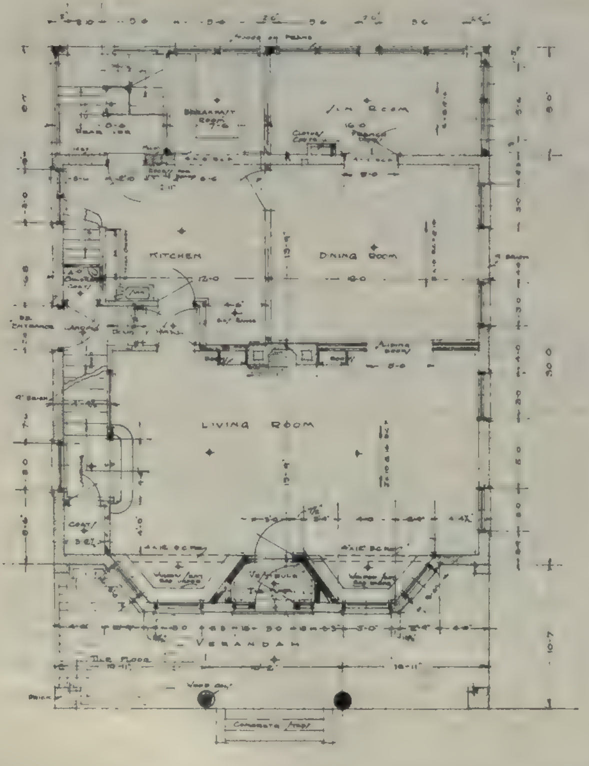
The attractive home illustrated in this article has just been completed for Mrs. Harry Knight, on Bayfield Crescent, Toronto. It is evident, from the photograph, that it is developed along the lines of the stucco type that is so much in vogue at the present time, the construction being solid brick throughout with stucco facing. The appearance of the structure will be considerably enhanced by the addition of shutters on all windows. At the time of the taking of the photograph this had not been done.

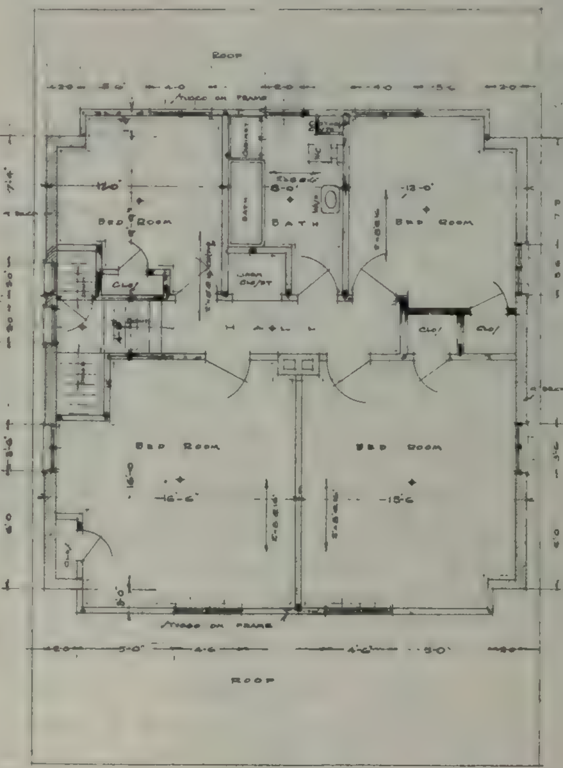
The house is of two storeys, containing nine rooms. The chief feature of the layout is a large living room, 15 ft. 9 in. by 28 ft., located across the entire front of the house. The front entrance opens through a small vestibule directly into this living room, a design that dispenses with the necessity of a hall. The dining room opens off the living room through large sliding doors and connects on the other side with a sun room at the back of the house. The kitchen adjoins the dining room and access is also made to the living room through a small rear hall. One of the features that seems to be greatly in favor in medium size houses, and which is included in this residence, is a small breakfast room, adjacent to the kitchen. Both back and front doors are provided the latter opening from the living room through two landings to the upper hall.

A study of the second floor layout discloses four bed rooms of ample dimensions each with closet space and each entered directly from a straight simple hallway, in which a linen closet is provided. A bathroom, tiled and equipped with the most up-to-date fixtures, is centrally located, so as to be easily accessible from all bedrooms.



In the basement, a large play room or billiard room is provided for. The boiler for the hot water heating system is oil burning and dispenses with the necessity for extensive coal storage space. The architect was Mr. F. K. Hyslop, of Toronto.





### FAVOR PAVING BLOCKS

In their work of rehabilitation of the railway system, the Toronto Transportation favored the use of paving blocks, particularly on main streets and at intersections. Brodies, Ltd., Bleury St., Montreal, supplied a large number of these blocks, aggregating some 600,000 in all.

## Mainly Constructional

### East and West—From Coast to Coast

The recent severe weather in Saskatchewan has resulted in the closing down of all road work throughout the province for this season.

The new $200,000 bridge on the Dundas road from Toronto to Hamilton, over Sixteen-Mile Creek, has been completed and was officially opened yesterday.

The civic works department, at Toronto, spent $10,993,337 in the first eleven months of this year, as compared with $9,501,286 in the same period last year, according to the interim report of Works Commissioner Harris issued recently.

Prof. Lewis T. Rutledge, of Queen's University, Kingston, Ont., addressed the Montreal Branch of the Engineering Institute of Canada on the subject "Professor Einstein's Theory of Relativity and Gravitation", at a recent meeting of that body.

As a means of relieving the unemployment situation in Ontario, a start has been made on the Ontario end of the Kenora-Winnipeg Highway, which will eventually form the main highway link between the two provinces. Work was commenced at Keewatin, Ont.

The large winter fair building, at Brandon, Man., has been completed with the exception of a few minor details of interior work. The contractors, Messrs. Carter-Halls-Aldinger Co., of Winnipeg, completed the construction work two weeks ahead of the schedule time.

The plant of the Canada Cement Company, at Port Colborne, Ont., has been closed down for repairs this month. About fifty per cent of the employees, however, have been retained to assist in the repair work. It is expected operations will be resumed about the first of the year.

The Builders' Exchange at Montreal has refused the demands of the District Council of Carpenters & Joiners for a 75 cent rate, 44-hour week, "closed shop" conditions and the right to strike. Carpenters, it is claimed, can be obtained at wages considerably below those asked for.

A fire at Port Weller, Ont., recently, destroyed considerable plant and material, including a mixer and seven cars of cement for use on the Welland Ship Canal construction work. One hundred and fifty workmen are out of employment, as a result, until the damage is repaired.

Fire losses in Canada during the week ended December 7 are estimated by the Monetary Times at $457,500, compared with $258,500 the previous week. Fire losses in Canada in November were $1,818,750, compared with $2,199,700 in October, and with $2,769,800 in November last year.

The municipality of Verdun, P. Q., recently passed a by-law authorizing a loan of $50,000 for public works and improvements. This money will be spent on new pumps for the water works department, motor machinery for fire stations, additions to pump house No. 1 and for the opening of new streets.

A recent statement is to the effect that work will be commenced on the proposed new $1,500,000 hotel at London, Ont., in the very near future. The hotel will be situated at the corner of Richmond and Fullerton streets and will contain about 300 rooms. Messrs. Anglin-Norcross, Limited, of Montreal, are the contractors.

The Dominion Steel Products plant, at Brantford, Ont., recently closed down temporarily. The reason given is that stock has accumulated to such an extent that manufacturing operations will have to be suspended for a period in order to dispose of some of the surplus. About 200 men are affected by the shutdown.

Mr. Justice Bruneau, of Montreal, recently handed down a judgment which set aside the city's claim of exemption from obligations imposed by the Workmen's Compensation Act, in an action brought by John Daly, a civic employee, for compensation for injuries sustained while employed on the city's paving work. According to an amendment to the Act, corporations are now included in the list of employers liable under the Act.

The Mason Contractors' Association of the United States and Canada met recently in convention at London, Ont., and elected the following officers for the coming year: Mr. Robert Gillespie, of St. Louis, Mo., (re-elected) president; W. H. McGarvey of Cincinnati, secretary-treasurer; Harry Fenton, of Indianapolis, counsellor; Harry Jennings, of Toronto, vice-president for the Province of Ontario. The Association decided to hold next year's convention at Columbus, Ohio.

The first "get-together" conference of the Association of Professional Engineers of Alberta was held recently in Calgary. Mr. R. A. Brown, president of the association, was the chief speaker. He defined the ethics and standards of the profession and outlined the qualifications necessary to become an engineer. Professor Wilson, of the University of Alberta, registrar of the association, and Dean Boyle, of the Faculty of Applied Science, University of Aberta, were other prominent speakers at the conference.

The Canadian Pacific Railway Company has drawn up a tentative agreement in connection with the proposed construction of a Union Station, at Peterborough, Ont., for the consideration of the other parties interested, the Grand Trunk Railway and the Railway Committee of the City Council. Negotiations have been under way for some time and it now begins to look as if they were going to bear fruit. The agreement has found favor with the G. T. R. officials and is under consideration by the civic authorities. A suitable site is available for the proposed structure at the corner at the corner of Townsend and Bethune Streets.

### Obituary

Mr. William John Stickwood, prominent brick manufacturer of Newmarket, Ont., died at his home in that town recently, aged 74. Deceased was born in Cambridgeshire, Eng., and came to this country at an early age, first taking up residence in the United States and later coming to Canada, residing in Toronto for a few years and then going to Newmarket, where he established a brick manufacturing plant.

Mr. R. L. Lindstrom, superintendent of the Montreal works of the Canadian Steel Foundries, Limited, died recently at his residence, 623 Durocher Avenue, that city, from pneumonia. He was 32 years old and was born in Moline, Ill.

### Trade Incorporations

Wallace & Tiernan Ltd., head office, Ottawa, Ont., to carry on the business of consulting, sanitary and mechanical engineers, capital $65,000.

# CONSTRUCTIONAL ACTIVITY

## Period of December 14 to December 20, 1921

***Dominion Wide Service Exclusive to "Contract Record & Engineering Review"***

### Waterworks, Sewerage and Roadways

**Dundas, Ont.**
Construction of sewer is contemplated by Town Council. C. R. Murdock, Engr.

**Montreal, Que.**
City Council plan construction of trunk sewer. A. E. Doucet, Engr.

**Ottawa, Ont.**
City Council will construct watermains at cost of $42,325 by day labor. A. F. Macallum, Commr. of Works.

#### CONTRACTS AWARDED

**Brockville, Ont.**
Excavation contract for sewer costing $25,000 for City is awarded to Chisholm Wellage Co., Lancaster.

**Hamilton, Ont.**
J. D. Armstrong, 871 Main St. E., is awarded general contract for construction of sewers costing $8,500 on Proctor Blvd., Main St. and alley, for City.

**Saanich, B.C.**
Yarrows, Ltd., Esquimault, B.C., awarded sub contract for supply of smaller sizes of cast iron pipe for Saanich Mun. Council, to Balfour, Guthrie & Co., 739 Hastings St. W., Vancouver.

**St. Lambert, Que.**
General contract for sanitary sewers costing $15,000 for Town is placed with Leger, 76A Aird Ave., and Tardif, 60 Adam St., Montreal.

### Railroads, Bridges and Wharves

**Montreal, Que.**
City Council contemplate construction of viaducts on Papineau Ave., St. Hubert, Baby, Masson and W. Notre Dame Sts. A. E. Doucet, Engr.

City Council plan reconstruction of subways on Wellington and E. Ontario Sts.

### Public Buildings, Churches and Schools

**Clover Bar, Alta.**
Erection of church is contemplated by United Methodist and Presbyterian Church. E. Keith, secy., Clover Bar, Alta.

**Hickson, Ont.**
F. W. Nicolls, architect, 13 Temple Bldg., Brantford, is preparing plans for school to cost $16,000 for School Bd.

**Hamilton, Ont.**
Plans are drawn for adding 3rd storey to court house at cost of $40,000 for Wentworth County Council. J. J. MacKay, architect, Bank of Hamilton Bldg.

Erection of office bldg. at cost of $150,000 is contemplated by Wentworth County Council.

Erection of hospital for contagious diseases at cost of $15,000 is contemplated by City.

**Montreal, Que.**
Plans are prepared for church for Fairmount Presbyterian Church. MacVicar & Heriot, architects, 628 Union Ave.

**St. John, N.B.**
F. Neil Brodie, architect, 42 Princess St., is preparing sketch plans for school to cost $75,000 to be erected on Burpee Ave. for R.C. Bishop of St. John.

**St. Lambert, Que.**
By-law was passed authorizing erection of high school to cost $90,000 for Protestant School Cmsn. Ross & MacDonald, architects, 1 Belmont St., Montreal.

**Stratford, Ont.**
T. J. Hepburn, architect, 29 Downie St., has plans and will receive tenders until Jan. 3rd for erection of addition to school for School Bd.

Erection of school at corner of Brunswick and Well Sts. is contemplated by Separate School Bd.

#### CONTRACTS AWARDED

**Barrie, Ont.**
A. Moffatt, Barrie, has heating and ventilating contracts for court house for Simcoe County Council.

**Gravenhurst, Ont.**
Plumbing contract for hospital costing $450,000 for Muskoka Free Hospital for Consumptives, 223 College St., Toronto, is awarded to Wright Bros., Ltd., 92 Summer hill Ave., Toronto. C. S. Cobb, architect, 71 Bay St., Toronto, will receive tenders for water supply.

**Griffin Cove, Que.**
Edgar Pelletier, St. Cyrille St., Quebec, is awarded general contract for interior decorating of church at cost of $30,000 for Parish.

**Halifax, N.S.**
General contract for erection of school costing $8,000 for School Bd. is awarded to J. P. Murphy, 15 Cogswell St.

**Montreal, Que.**
Contract for excavation and foundations required for police courts costing $3,000,000 for Prov. Govt., Dept. Pub. Works, is placed with Foundation Co., Ltd., 224 St. James St., Montreal.

Contract for comp. flooring for school costing $500,000 for Protestant School Bd., 36 Belmont St., is placed with Stinson Reeb Builders' Supply Co., Ltd., 45 Alexander St.

**Sardis, B.C.**
Additional contracts for Indian School costing $29,000 for Dom. Govt., Dept. Indian Affairs, Ottawa, are: Sheet metal, asbestos board and asbestos insulation, Pacific Sheet Metal Works, Granville St., Vancouver; plumbing and heating, Orr Bros., 1210 Granville St., Vancouver.

### Business Buildings and Industrial Plants

**Aylmer, Que.**
Geo. R. Nash, Aylmer, Que., has plans and will receive tenders, no closing date set, for erection of business block to cost $15,000.

**Caledonia, Ont.**
Ebsary Gypsum Co., Ltd., 81 Victoria St., Toronto, will erect warehouse.

**Grand Mere, Que.**
A. Normandin, 115 3rd Ave., Shawinigan Falls, is constructing a foundry at cost of $5,000, work by day labor.

**Guelph, Ont.**
Northern Rubber Co., Ltd., Metcalfe St., will erect warehouse at cost of $11,000. Mr. Cromer, Mgr.

**Hagersville, Ont.**
Canada Seed Co., Hagersville, will erect warehouse at cost of $12,000. R. MacDonald, architect.

**Hamilton, Ont.**
B. H. Prack, architect, 50 Bay St., Toronto, is preparing plans for store and apts. for P. D. Davidson, 1129 Main St. E., Hamilton.

**Montreal, Que.**
L. W. Chaput, 147 Luke St., plans erection of store and 6 flats on Sherbrooke St. W.

D. W. Dickson, 56 Windsor St., contemplates erecting stores and flats on Bates Road.

**Norwich, Ont.**
Plans are being prepared for planing mill to cost $10,000 for W. W. Avey.

**Stettler, Alta.**
Wm. Drewis, Stettler, is remodelling flour mill.

**Thetford Mines, Que.**
Plans are being prepared for alterations to factory to cost $7,000 for Thetford Creamery, Ltd. Eudore Deveau, secy.-treas.

**Toronto, Ont.**
E. G. Wilson, architect, 42 Langley Ave., is preparing plans for 4 stores and apts. to be erected on Bloor St. W.

H. W. Ormerod, 21 Chisholm Ave., is building 2 stores and apts. at cost of $22,000.

G. W. Lucas, 98 Bathgate Ave., is building 4 stores and apts. costing $10,000 each.

#### CONTRACTS AWARDED

**Aylmer, Que.**
General and carpentry contracts for 3 stores and apts. costing $25,00 for Dr. F. W. Church, Main and Bancroft Sts., are awarded to Diogene Ricard, 34 St. Hyacinthe St., Hull. Additional contracts are: Roofing, Pedlar People, Ltd., Oshawa, Ont.; plumbing and heating, L. Gendron, 89 Bridge St., Hull; painting, Raoul Jacques, 93 Maisonneuve St., Hull; electrical, W. Lapensee, Hull.

**Berwyn, Alta.**
David Dale, Peace River, Alta., will

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## *A Word of Encouragement*

"It is possible to report a slight improvement in general business conditions during the past two months; and although this improvement has not been of a duration or scope to warrant any great optimism, yet it is exceedingly welcome to a business world which has suffered little but reverses since the summer of 1920".

This is from a report issued by the Royal Bank of Canada, our second largest financial institution. Coming from such a source we have real reason to be encouraged, for surely there is no one better situated to form correct judgments than the manager of a bank having branches all over the Dominion and these branches in closest touch with the financial conditions of the districts they serve. It is also to be remembered that our banks are recognized as almost ultra-conservative. We may thus feel doubly assured that the Royal Bank management actually sees "a slight improvement."

This should be enough to give us all encouragement and inspiration to throw our best into the year 1922. It is an old-fashioned idea that business conditions are things uncontrollable. We know to-day that the human factor is all important. We can do what we think we can, and if we set out with a determination to make 1922 a year of activity, that will be a big factor in making it so.

It was a wise man who said that it's not so much a matter of just where we are at the moment as which way we are going. Apparently, to-day, we've got faced around in the right direction. Every extra bit of energy expended, therefore, adds to the momentum of returning prosperity. Let's all—everybody in the building and construction and allied industries—take courage from "the slight improvement" and, with determination, set ourselves the goal of "normal conditions before the end of 1922."

## *Construction Equipment Needs Proper Storage During Winter Months*

It is well at this time of year for contractors to remind themselves of the necessity for proper storage of their construction plant and materials. It would seem as if a word in this connection is quite unnecessary and it should be so, but the fact is that many contractors are allowing valuable equipment to rust and deteriorate through failure to house it properly during the winter months. On a number of occasions in the last few weeks the editor has observed mixers, hoisting outfits, paving machines, boilers, road making equipment and other pieces of plant lying on the roadside or in an open field, absolutely unsheltered from the attacks of the elements and unprotected from rust and corrosion. It is obvious that under conditions such as these no machine will stand up or give lengthy service. The depreciation which contractors must write-off will, therefore, be very heavy.

Quite aside from being an obvious unbusinesslike manner of caring for equipment which is expensive in the first place, the failure to observe proper storage precautions is making those contractors less able to cope with future business. Not only will they be unprepared through not having on hand equipment which will render good service, but they must necessarily have to bid high in order to pay for the plant which they have allowed, voluntarily, to run down. It is safe to say that competition for new business will be very keen and those contractors will be best prepared for it who can offer their clients immediate service with plant in good working order and who bid a close figure without any items relating to abnormal plant depreciation or replacement.

There is no need to outline the necessary precautions for winter storage of equipment as every contractor should be able to take such measures as will preserve his machines in good order throughout the winter. In fact, the wide awake contractor will use the coming months for a general overhauling of his whole plant so as to be prepared adequately for the spring rush of construction business. The day of excessive profits in the contracting business is over and the wise man will seek every possibility to shave down his expenses to the last cent. One of the first departments of his organization upon which to begin is that which handles and stores his construction materials and equipment.

## *Every Contractor Should Attend the Construction Conference in Hamilton Next Month*

Every contractor who takes his work seriously should be making preparations to attend the construction conference in Hamilton next month. Called by the Association of Canadian Building & Construction Industries, it will have a very beneficial effect on the business as a whole and prove valuable to each individual contractor, if it is properly supported and attended. The association, formed during war years, is

### No. 75

## Canada's Engineers—R. O. Sweezey

**Robert Oliver Sweezey has recently entered the consulting engineering fraternity in Montreal, specializing in water powers, pulp and paper, timber lands and financial reports. Practice on his own account commenced only a few months ago, but prior to that, Mr. Sweezey had acted in a consulting capacity for various bank institutions, investment houses and public corporations. From 1914 to December of 1916 he was on the staff of the Royal Military College, Kingston, Ont., as professor of field engineering.**

**Mr. Sweezey is a native of Three Rivers, Quebec, where he was born in 1883. He was educated at a private school in Chicoutimi and at Queen's University, from which he graduated with the degree of B. Sc. His practical training has been quite varied and includes experience as a lumberman and timber limit operator, location and construction work for the Transcontinental Railway and exploration of the economic resources and timber lands of Northern Ontario and Quebec, and other parts of Canada.**

**While he has a fondness for golf, he also includes among his recreations the study of forestry and geology and thus keeps himself in constant touch with the membership in the Engineering Institute of Canada and in the Canadian Institute of Mining and Metallurgy.**

Mr. R. O. Sweezey

**His affiliation with professional organizations includes developments in these fields so akin to engineering.**

carrying on unpretentiously but faithfully a great work in the interests of the contracting fraternity of Canada. It still has a great work to perform, but its efforts will bear fruit only insofar as they are aided by the support and enthusiasm of its members. In the past the construction industry has sadly felt the need of unity and co-operation among its members and now, when an opportunity has been offered for a display of united effort, it behooves every one to put his shoulder to the wheel and push the movement forward, with accelerating momentum, until he places the construction business on a firm footing in its rightful place as one of the greatest industries in the country.

Progress in the attainment of these objects has been slow because contractors have not been educated to see the value of co-operative organization. They are now becoming enlightened, however, and it is to be hoped that before very long the entire industry will be organized on a substantial basis, capable of taking its rightful place in the industrial activities of the Dominion. The conference, which will be held in Hamilton next month, has this as one of its prime objects. With proper support from contractors and supply men and with a display of optimism and enthusiasm the convention can be made a great success. It may, indeed, be an epoch-making event in the history of the contracting industry, for it comes at a time when serious problems confront industry and business and when a proper solution must be found to these problems if business is to be re-established and re-invigorated. We urge every contractor who can possibly break away from his business ties to go to Hamilton for the four days, January 17, 18, 19, and 20, and boost with his presence and his counsel the industry with which he is affiliated.

An excellent program of topics for discussion is promised and it is beyond question that every person attending the proceedings will get fresh viewpoints and be better prepared for his future work.

### Wire Company Incorporated

The T. G. Rice Wire Manufacturing Company, 134 King St. W., Toronto, has recently been incorporated under the name of Rice Wire & Metal Goods, Ltd. The officers of the new firm are as follows: president, T. L. Rice; general manager, C. Collins, late general manager for Canada of the Toledo Scale Company; secretary treasurer, J. W. Fitzgerald.

### Galt Activities

Mr. Arthur C. Trory, Galt, Ont., has secured the contract for alterations to the old Royal Bank building for Mr. A. H. Appleton, who will occupy the building for women's ready to wear; approximate cost, $2500.00. He has also under way a $7000.00 residence for Mr. W. Osborne.

### Law Controls Tank Construction

In Massachusetts the construction of "tanks or containers for the storage of fluids other than water" is controlled by a law which repuires that permits for constructing, maintaining or using any such tanks must be obtained from the chief of the district police (in the metroplitan district, from the fire prevention commissioner). These officials are required to make rules and regulations for such tanks, subject to approval of the governor and council. The law, which was passed as a result of the Boston molasses tank accident in 1919, does not apply to tanks constructed principally of wood, or to tanks of 10,000 gal. or less capacity.

# The Mushamush Hydro-Electric Plant

## A Scheme Undertaken by the Nova Scotia Power Commission Which, While Small, Conforms to Present-Day Standards of Efficiency, Simplicity and Economy.

By K. G. CHISHOLM
Assistant Engineer, Dominion Water Powers Branch.

On October 1st the Nova Scotia Power Commission put in operation a reconstructed development on the Mushamush river near Mahone, which by contrast with the original development strikingly illustrates the present practice of simple, sturdy, hydro-electric units of the vertical, direct-connected type with high efficiency, even at comparatively low heads. The new development, although small, is considered to conform to the present-day standards of efficiency simplicity and economy.

Previous to the present development a plant at the same site owned and operated by the Lunenburg Gas Company, supplied the lighting requirements of Lunenburg with night service only. In 1920, a request for current was received from the municipality of Riverport. In addition, West LaHave, Mahone, Blockhouse and Bridgewater, were in communication with the Commission and it became apparent that there were existing and future markets for power in the district considerably in excess of the available sources of supply, a condition which, under the Provincial Water Power Act, the Power Commission was authorized to meet in the way it deemed most advisable.

After careful study of several alternative propositions, it was decided to buy out the property and rights of the Lunenburg Gas Company on the Mushamush river, including among other items their small hydro development near Mahone with the storage dams and flowage rights pertaining thereto, as well as their transmission line to the outskirts of Lunenburg, and to utilize as much as possible these rights and properties in the construction of a new plant more liberally designed to meet the present and future demands of the district.

The company's development near Mahone consisted of a head dam with timber flume built into the dam, and wooden power-house immediately below. The dam about 400 feet long at highwater and 24 feet in maximum height consisted of a central timber spillway section with an earth embankment at both ends. The turbine installation consisted of a pair of 27 inch, horizontal, S. Morgan Smith cylinder gate wheels mounted on the same shaft and discharging into a common steel plate cylindrical draft tube. They were set in the bottom of the timber flume in a timber draft chest made up at the site. The shaft projected through the end of the flume into the power-house and the generator on the upper floor of the power-house was belted to a 6-ft. diameter cast iron pulley on the turbine shaft. The wheels were rated at 386 h.p., 280 r.p.m., under 24-ft. head, and the Westinghouse 3 phase generator at 200 kv.a., 3500 volts and 600 r.p.m. The exciter was belted to the generator shaft. This small plant had been in operation for 13 years and had given reasonably good service.

In connection with the studies made by the Commission's engineers, a test of the old plant was made in February 1921. The results of this test may be interesting as being representative of small plants of its class. A close inspection after the test showed the wheel and bearings to be in good condition, although some play on the bearings was observed. As far as the wheel and mountings were concerned, it was apparent that the full original efficiencies of the wheel should have been obtained, but in fairness to the manufacturers, and in explanation of the low efficiencies actually obtained, it should be stated that the tail-race conditions immediately under the turbine were not good and piling up of the water took place, with consequent loss of operating head. The extent of this piling up could not be ascertained as it occurred around the draft tube beneath the flume. The average results of the tests made are given in the following summary.

| Gate | Head | Speed | Discharge | Turbine Effcy. |
|---|---|---|---|---|
| Full | 21.8 | 275 | 159 | 63.0% |
| ¾ | 21.9 | 280 | 139 | 56.6% |
| ½ | 22.1 | 280 | 99 | 46.2% |

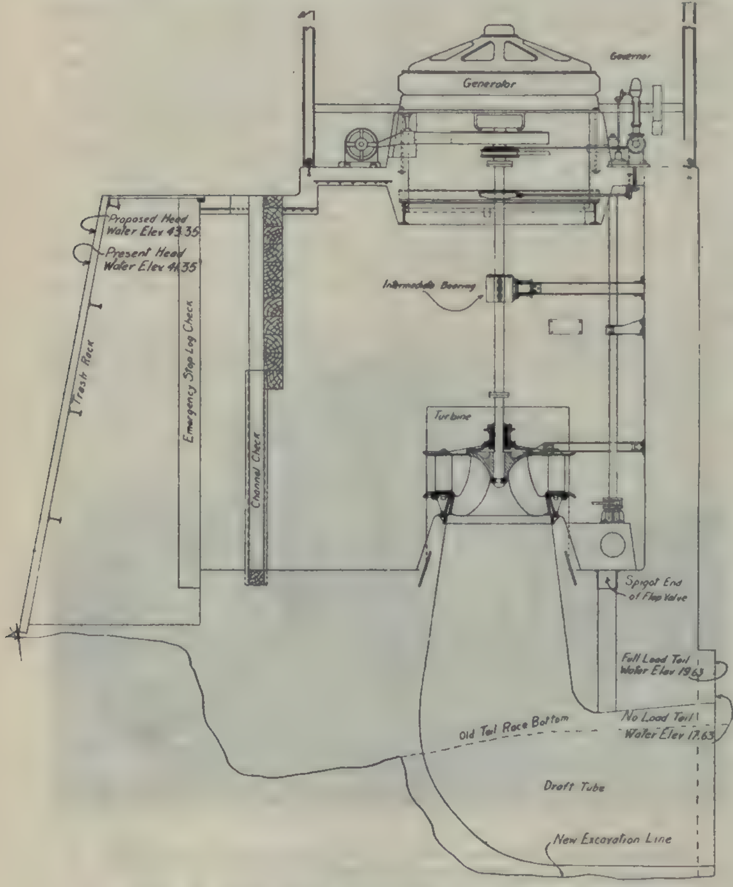
For the new development it was decided to use the same head of 22 feet, utilizing the existing dam, but instead of the old timber flume and power-house to build a new plant with better construction throughout and with a larger turbine in a more permanent and efficient setting. The turbine was selected for a head of 24 feet as it is the intention to increase the height of the dam by two feet when the load becomes large enough to warrant doing so.

Exterior view of power house of the Mushamush hydro-electric development in Nova Scotia

In selecting equipment for the new plant, it was necessary to bear in mind that the new development must be begun and carried to completion as early as possible. Some consideration was given to utilizing a high speed runner of the Nagler type but for various reasons this was not entertained, particularly when it was found that the S. Morgan Smith Company had already constructed a wheel suitable in every respect, which could be shipped on short notice. It was also fortunately learned that the General Electric Company had under construction in their works at Erie, Pa., a vertical shaft water-wheel generator of suitable speed and capacity for direct connection to this turbine.

The general layout of the new plant is shown in the figures presented herewith. It includes a concrete flume with a quarter turn flaring draft tube moulded in the solid concrete of the foundation. The setting is of the vertical type with ring, gates and cover plate supported on a concrete pedestal in the flume bottom, and with runner, shaft and generator rotor supported by a General Electric spring thrust bearing supported on the generator stator. The circular pit beneath the generator permits inspection of exciter, governor pump, governor fly-ball and brake pulleys mounted also on the turbine shaft. The braces from the turbine cover plate to the flume walls, as well as the intermediate guide bearing supports and the brake supporting frame, are bolt fastened and removable, so that if necessity should arise the turbine runner may be hauled up through the opening in the power-house floor within the generator pedestal.

To close off the water from the flume a timber gate and hoisting mechanism is provided in front of the power-house, and for safety's sake emergency stop-log checks are also provided. A flap valve permits of unwatering the flume below the level of the turbine gates. Access to the interior of the flume can be had through a trap-door in the power-house floor and iron ladder rungs in the flume wall.



Section of power house showing the layout of the hydraulic and electric units

The flume is of reinforced concrete 12 feet 6 inches wide by 33 feet long inside dimensions. A reinforced concrete deck forms the power-house floor. The weight of the generator, shaft and turbine runner is carried on an I beam resting on the flume walls.

The rating of the new hydraulic unit for 24 feet head is 825 h.p. at full gate and 180 r.p.m. The generator rating is 750 kv.a. at 80% P. F., 6600 volt, 3 phase, 180 r.p.m.

Although no opportunity has yet arisen for testing the new plant, the guaranteed turbine efficiency curve runs from 73% at half-gate to 88% at .95 gate, dropping off to about 80% at full gate. This is in sharp contrast to the efficiencies obtained from the old plant. The generator efficiencies are high, ranging from 91.5% at full load to 88.5% at half load, at 80% P. F.

For reasons of economy and speed in delivery of equipment, a standard horizontal shaft exciter is used, belt-driven from the main shaft by means of an idler bolted to the under side of the generator stator frame and a quarter turn in the belt. Undoubtedly from a purely mechanical standpoint, either a belt-driven vertical exciter, or an exciter direct-connected to the main shaft would have been preferable, but economy and more particularly speed of delivery, decided against them. Not only would a direct-connected exciter have been expensive but it would have held up delivery of the generator which was already under construction. Furthermore, the Commission was already in possession of a horizontal shaft exciter of the proper rating and this was accordingly used. However, the change to a vertical shaft exciter can be made if found desirable at any time. Some trouble has been experienced with the exciter drive, first in the idler pulley and then in the belt itself, due to stretching of the new belt. This has now been overcome and the drive is operating quite satisfactorily with a leather belt.

For the sake of economy, the power-house was made as small as possible, consistent with properly housing the machinery. Its outside dimensions are 22 ft. by 24 ft. 2 ins. It consists of a framework of 2 x 6 timber covered on the outside with cement stucco laid on Bishopric-board and on the inside with gypsum fibre-board, the whole giving a building cheap, fire-resistant and easily constructed. The roof covering is of red "Everlastic" asphalt slate shingles. The building presents quite a creditable appearance as the illustration shows.

The use of the old site for the new development necessitated a shut down and a cessation in the delivery of power. Every effort was made to reduce the period of shut down to a minimum and speed of construction was an essential of the work. Work was commenced on the morning of August 10th and on October 1st the new plant was delivering energy to the line. Furthermore, the two municipalities supplied were without lights for only one night, on the 10th of August.

The old plant was shut down at midnight of August 9th and immediately unwatering sluices were opened at the head dam. At daybreak a gang had commenced to dismantle the power-house. By seven p.m. exciter and generator had been moved by hand to the site of a temporary plant 150 feet away and connected to a steam engine and boiler already hauled to the job and the generator rewired into the line. Except for the fact that exciter trouble developed, the temporary plant would have been in operation that same night. As it was, current was turned into the line at dusk of the following evening and the people of Lunenburg, who had been prepared to go without lights for the whole period of reconstruction, actually were deprived for only one night. On a job large enough to warrant the presence of adequate apparatus, this would be no feat worthy of mention, but considering the manhandling of heavy machinery necessary under the circumstances, it was considered very satisfactory. It is further of interest to note that the initial schedule of 45 working days was realized.

The costs of the various phases of the work which were very closely followed and carefully distributed, are unfortunately not available at the date of writing, but can be furnished later. The total cost is, however, within the estimate of $48,000.00.

Both the design and execution of the work were carried out by the Commission's own engineering and construction organization, under the immediate direction of Mr. Harold S. Johnston, hydraulic engineer of the Commission, with the writer as engineering assistant and instrument man during the period of reconstruction. K. H. Smith is chief engineer of the Commission, which consists of Hon. E. H. Armstrong, chairman, R. H. Mackay, secretary and F. C. Whitman, commissioner.

# Pumping with Compressed Air

## How Air may be used to Speed up the Work—Various Methods of Pumping and the Equipment Necessary—Air Often Proves Superior to Steam or Electricity

By F. A. McLEAN
Canadian Ingersoll Rand Co., Sherbrooke, P.Q.

One of the most important fields to which compressed air has been applied is the raising and conveying of water and other liquids in mines, chemical and industrial plants, towns, cities, etc. There are a number of ways in which air is harnessed for this purpose; many are more or less worthless while others are of great value and are often the only possible solution of the problem of obtaining an abundant supply of pure water or of conveying liquids in certain localities or under certain conditions.

Local conditions largely determine the nature of the method employed in individual cases as well as the question of convenience and economy. The amount of air consumed varies widely with the systems used as compared with the amount of work done and in all cases the amount of air used must be in excess of the theoretical requirements, as compressed air like other forms of power, will do nothing for nothing.

### Operating Piston Pumps By Compressed Air

One of the oldest methods of raising water by air is to use air in place of steam in reciprocating pumps which may be either of the simplex or duplex type. This method has the disadvantage of being one of the most extravagant, but there are some cases, as in mines, tunnels, excavations, etc., where it is so convenient to do this, that the question of power economy becomes only a minor consideration.

Direct acting piston pumps, whether of the simplex or duplex type, have gained an unsavory reputation as "steam-eaters," in fact they are often among the most uneconomical appliances known. As a rule the simplex pump is better in this respect than the duplex, but even the makers of this type figure on 150 pounds of steam per horse power hour in their pumps. Others claim all the way from 125 to 250 pounds for their machines, so that the first figure may be taken as a happy medium, and serves to emphasize the low efficiency of the direct acting pump, especially when it is compared to the ordinary automatic steam engine which in itself is no hoarder of steam and usually requires from 30 to 35 pounds per horse power hour.

Thus it is evident that when an attempt is made to use compressed air in place of steam to drive direct acting pumps, it often results in a system the low economy of which is painful to behold. To offset this, however, a properly designed system, while not highly efficient, is exceedingly simple and cannot be drowned out.

For this reason air operated pumps are often applied to the unwatering of mine shafts which are too deep to permit the satisfactory transmission of steam. Where the air is free from oil and the exhaust is not piped back into the compressor, it may be used to increase the air in the shaft or tunnel as is often done in the case with air driven rock drills.

### Losses Not Due to Air Itself

It is rather interesting to note that of all the losses which occur in this system and which reduce its ultimate efficiency to about 21% so that about 5 h.p. is

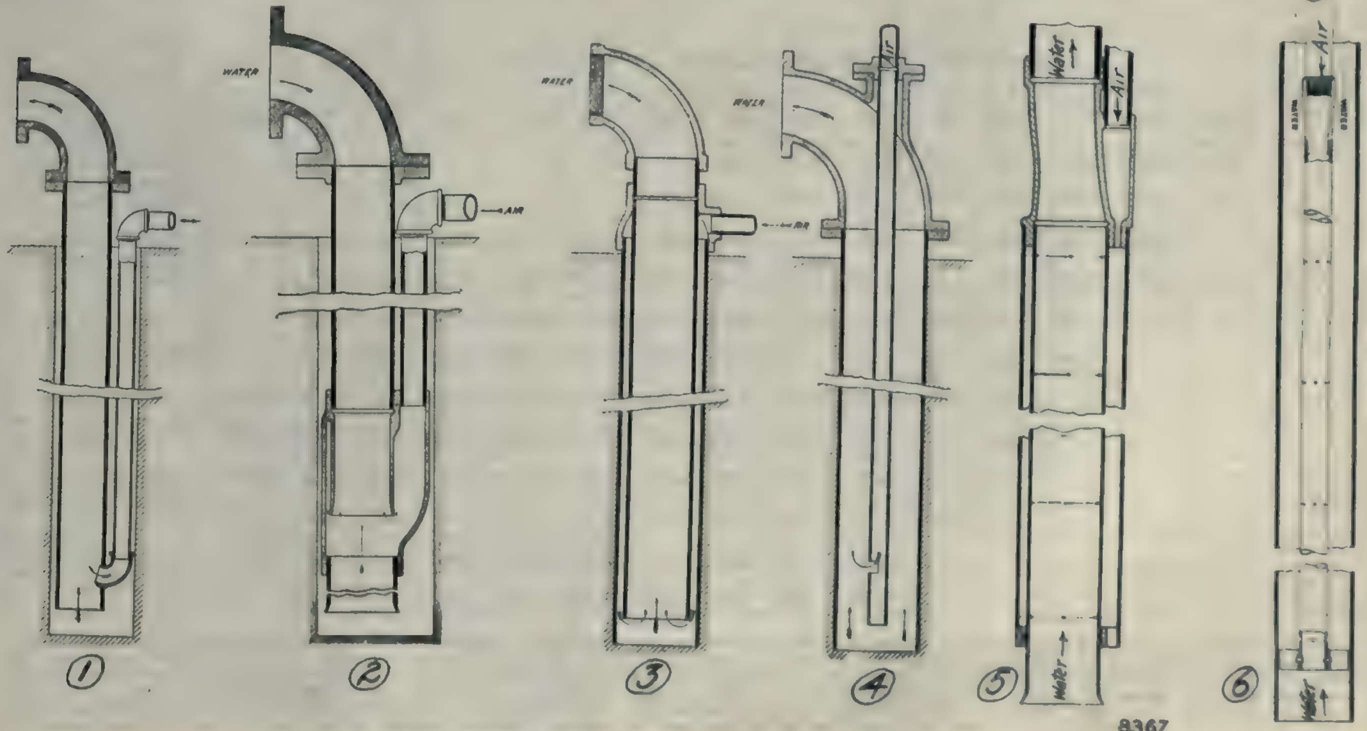


Fig 1—Methods of piping wells for pumping by the air lift system

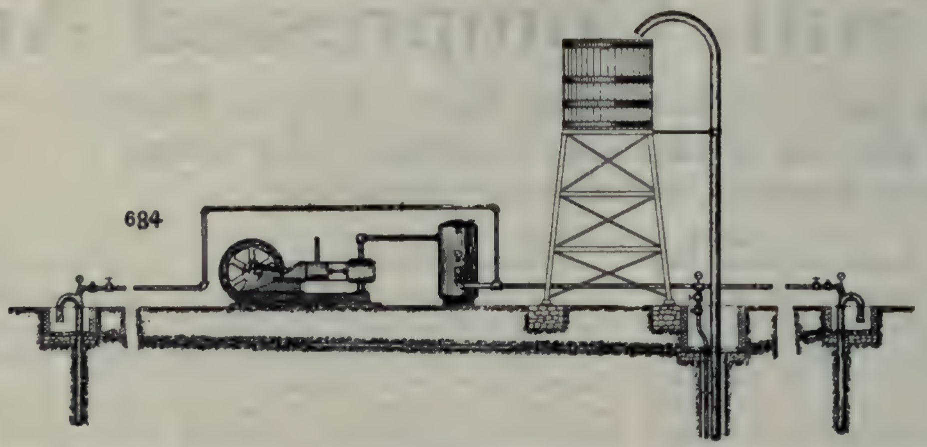


Fig. 2—Diagram of an air lift operated by a steam driven compressor

required in the steam cylinder of the compressor in order to secure the application of 1 h.p. to the actual work of raising water, few of them are directly chargeable to air itself, but are due to defects inherent in the apparatus and in that system by which the air is harnessed.

### The Closed Circuit System

One of the simplest and most efficient methods of operating direct acting pumps is the "dense air" or "closed circuit" system, in which the same air is used over and over again, the exhaust from the pumps being piped back to the intake of the compressor under a limited pressure. Compressed air like a belt or a rope is a transmitter of power purely and simply, with the additional advantage that unlike belt or rope it never wears out and can be carried to any distance and at all angles. It has little inherent friction and may be transmitted with very high efficiency. Freezing is eliminated, since the moisture once removed cannot be returned. Condensation losses, always a factor to be reckoned with, in the transmission of steam are entirely absent with compressed air, which can be transmitted through systems of piping whose very length would prohibit the use of steam no matter how well insulated the system might be. Pumps designed to operate on air have smaller cylinders since the mean effective pressure is higher and the losses in clearance, which are often enormous in the ordinary pump, are entirely eliminated. The greatest economy of this system is secured, however, in compression, it being a well known fact that the greatest losses in compression occur at the lower pressures.

Air driven direct acting pumps have been largely used in mining, tunnelling, etc., and have had more attention on the part of engineers and manufacturers of compressed air of late years than was formerly the case.

### The Air Lift System

By far the most important application of compressed air to the pumping, elevating and transferring of liquids is the "air lift" and while this name is not strictly correct, no one has ever been able to suggest a better one. The water works of many cities and towns in the United States, Canada and Mexico are

| Ratio of Diameters | PERPENDICULAR HEIGHT, IN FEET, TO WHICH THE WATER IS TO BE PUMPED | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 225 | 250 | 300 | 350 | 400 | 450 | 500 | |
| 1 to 1 | 13.75 | 27.5 | 41.25 | 55.0 | 68.25 | 82.5 | 96.25 | 110.0 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | Air pressure at pump |
| | 0.21 | 0.45 | 0.60 | 0.75 | 0.89 | 1.04 | 1.20 | 1.34 | ...... | ...... | ...... | ...... | ...... | ...... | ...... | Cubic feet of free air per gallon of water |
| 1½ to 1 | ...... | 12.22 | 18.33 | 24.44 | 30.33 | 36.66 | 42.76 | 48.88 | 55.0 | 61.11 | 73.32 | 85.4 | 97.66 | ...... | ...... | Air pressure at pump |
| | ...... | 0.65 | 0.80 | 0.95 | 1.09 | 1.24 | 1.39 | 1.53 | 1.68 | 1.83 | 2.12 | 2.41 | 2.70 | ...... | ...... | Cubic feet of free air per gallon of water |
| 1¾ to 1 | ...... | ...... | 13.75 | 19.8 | 22.8 | 27.5 | 32.1 | 36.66 | 41.25 | 45.83 | 55.0 | 64.16 | 73.33 | 82.5 | ...... | Air pressure at pump |
| | ...... | ...... | 0.94 | 1.14 | 1.24 | 1.30 | 1.54 | 1.69 | 1.84 | 1.99 | 2.39 | 2.59 | 2.88 | 3.19 | ...... | Cubic feet of free air per gallon of water |
| 2 to 1 | ...... | ...... | ...... | 13.75 | 17.19 | 20.63 | 24.06 | 27.5 | 30.94 | 34.38 | 41.25 | 48.13 | 55.0 | 61.88 | 68.75 | Air pressure at pump |
| | ...... | ...... | ...... | 1.23 | 1.37 | 1.52 | 1.66 | 1.81 | 1.96 | 2.11 | 2.40 | 2.69 | 2.98 | 3.28 | 3.57 | Cubic feet of free air per gallon of water |
| 2¼ to 1 | ...... | ...... | ...... | ...... | 13.75 | 16.5 | 19.25 | 22.0 | 24.75 | 27.5 | 33.0 | 38.5 | 44.0 | 49.5 | 55.0 | Air pressure at pump |
| | ...... | ...... | ...... | ...... | 1.533 | 1.68 | 1.83 | 1.97 | 2.12 | 2.26 | 2.56 | 2.85 | 3.15 | 3.44 | 3.73 | Cubic feet of free air per gallon of water |
| 2½ to 1 | ...... | ...... | ...... | ...... | ...... | 13.2 | 15.4 | 17.6 | 19.8 | 22.0 | 26.4 | 30.8 | 35.2 | 39.6 | 44.0 | Air pressure at pump |
| | ...... | ...... | ...... | ...... | ...... | 1.79 | 1.98 | 2.06 | 2.104 | 2.34 | 2.62 | 2.88 | 3.18 | 3.36 | 3.23 | Cubic feet of free air per gallon of water |

**This table shows the pressure and volume of air required for any size pump. Reasonable allowances have been made for loss due to clearance in the pump and friction in pipes. To find the amount of air and the pressure required to pump a given quantity of water a given height, find the ratio of diameters between the water and air cylinders, and multiply the number of gallons of water by the figure found in the column for the required lift. This gives the number of cubic feet of free air. The pressure required on the pump will be found directly above in the same column. Example: The ratio between cylinders being 2 to 1, required to pump 100 gallons to a height of 250 feet. Under 250 we find at ratio of 2 to 1, the figures 2.11; 2.11 x 100=211 cubic feet of free air, and the pressure required is 34.38 pounds delivered at the pump piston.**

dependent on the air lift and its use for obtaining water from natural subterranean sources has rapidly extended of late years throughout the whole civilized world. It is also used for pumping oil wells, salt wells, for the unwatering of deep mines, providing pure water for breweries and bottling works, textile mills, saw mills and industrial plants of all kinds.

Due to the entire absence of moving parts in the air lift system and the fact that the exposed portions of the equipment can be made of lead, bronze or other corrosion resisting material, it is particularly suitable for transferring liquids such as oil, acid or alkaline solutions from one vessel to another, and when special wear-resisting metals are used, for handling gritty water, pulp, etc. The water from an air lift system is always as pure as the supply and some cases purer, as the aeration of water always results in its purification. Due to the expansion of the air, the water is slightly cooler than surface water in summer, and warmer in the winter, as, coming from a depth, it is protected against the temperature which prevails at the top of the well.

## Air Lift Requirements

The three principal requirements for an air lift are: first, the well or river from which the water is to be taken; second, a compressor to furnish air to pump the water, and third, the pipes to carry the air from the compressor to the source of water supply and to transport the water raised to the place at which it is to be used or stored.

**The Well or Source of Supply**—Practically all of the water obtained from drilling wells is rain water. Rain that is not evaporated or carried off in streams, sinks into the ground. It enters the porous rocks, sand and gravels with more or less ease according to the nature of the geological formation in different parts of the country.

A hole of large diameter is necessary for the installation of deep well pumps of the sucker type, but as the yield of this type of pump in proportion to the space it occupies is small, it has been thought permissible in some cases to reduce the diameter of the lower part of the well without seriously affecting the efficiency of the installation. After being in service only a short time, however, the yield of these wells was so reduced as to render it necessary to ream the well in order to obtain a sufficient supply of water. Under such conditions the "air lift" has more than once proved valuable.

In pumping river or lake water by the air lift system, wells may be sunk to the required depth in the bed of the river or lake, closed at the bottom and subsequently filled by the water running in at the top. Where water of greater purity than is obtainable by this method is desirable, it is often possible to sink wells in the bank of the river or lake at some distance from the edge; the intervening earth acts as a very efficient natural filter, which, with the aeration during the process of pumping, purifies the water quite effectively.

**The Compressor**—One of the most important considerations in planning the installation of an air lift system is the air compressor, on the careful selection of which depends to a large extent the ultimate efficiency of the installation as a whole. The capacity and method of drive must be determined by convenience and local conditions. For small installations straight line or vertical single stage machines are suitable and for larger installations, the multi-stage duplex types are more economical. The compressor may be either simple or compound, steam, gasoline or oil driven, motor driven by a short belt arrangement, or by a motor, the armature of which is directly mounted on the compressor shaft. Where the necessary power is already available the machine may be driven by a belt direct from a line shaft.

Gear drives are only suitable for very small portable compressors and are practically never used on larger machines owing to the intermittent loads to which this class of machinery is subjected.

**The Piping of the Well**—The proper piping of the well is a very important consideration and it is advisable to consult a reliable maker of air lift pumping equipment before proceeding with the work, as on the proper proportioning of the air and water piping, and the proper depth of submergence at which the air is introduced into the water column as well as the way in which it is introduced, depends(assuming the use of an efficient compressor) the success or failure of the entire system.

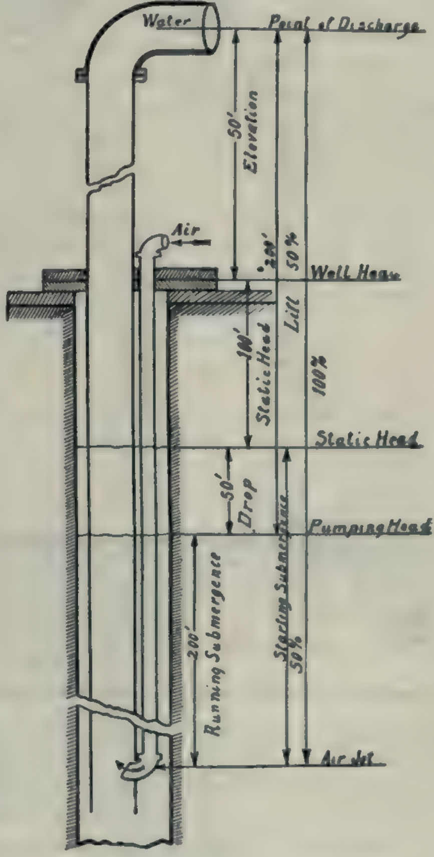


Fig. 8—Diagram of air lift illustrating definitions

There are several methods of piping a well, each having a number of supporters, those in most common use are being shown in Figure 1. The methods illustrated in sketches 1 and 2 of that figure are known as the side inlet or Pohle systems, after their inventor, Dr. Julius Pohle, and are generally used where the size of the well is large in proportion to the demand for water. The Saunders system, illustrated in sketch 3, consists of a central tube suspended inside the well casing, the air passing between the well casing and this tube through which the water is discharged. This system is suitable for wells of too small a diameter to permit the use of the side inlet type.

The third, or central air pipe system, sketch 4, is a reversion of the previously described arrangements and is used to obtain the largest possible output from a given size well. The air pipe is suspended inside the casing and the water discharges between this and the casing. The diameter of the air pipe depends on its length, and the pressure and volume of the air which it is to carry. While this system will give the largest yield from a well of given size, it is not as economical as the other styles, and hence is not as widely used now as it was once.

Large bubbles of air ascend through water at a much more rapid rate than small ones, and thus any device which will divide the air into very small bubbles before it becomes mixed with the water will reduce the slippage losses and increase the amount of water pumped per cubic foot of air used. The Imperial systems, sketches 5 and 6, are so designed as to break the air up into fine streams which greatly increase the efficiency of the system. Both types are open at the bottom and provide a ready exit for any dirt or scale which may be blown down the air pipe into the well. The Imperial class "VC" pump, as shown in sketch 6, is an improvement on the central air pipe system illustrated in sketch 4, and is adapted for use where the diameter of a well prohibits the use of the side inlet type, and is especially suitable for handling large quantities of water from strong wells. The casing in both of these pumps is made of steel tubing, and the air pipes of brass tubing, around the periphery of which are drilled small holes so spaced as to create back pressure of sufficient strength to prevent slippage losses and ensure control over the admission of air to the rising column of water.

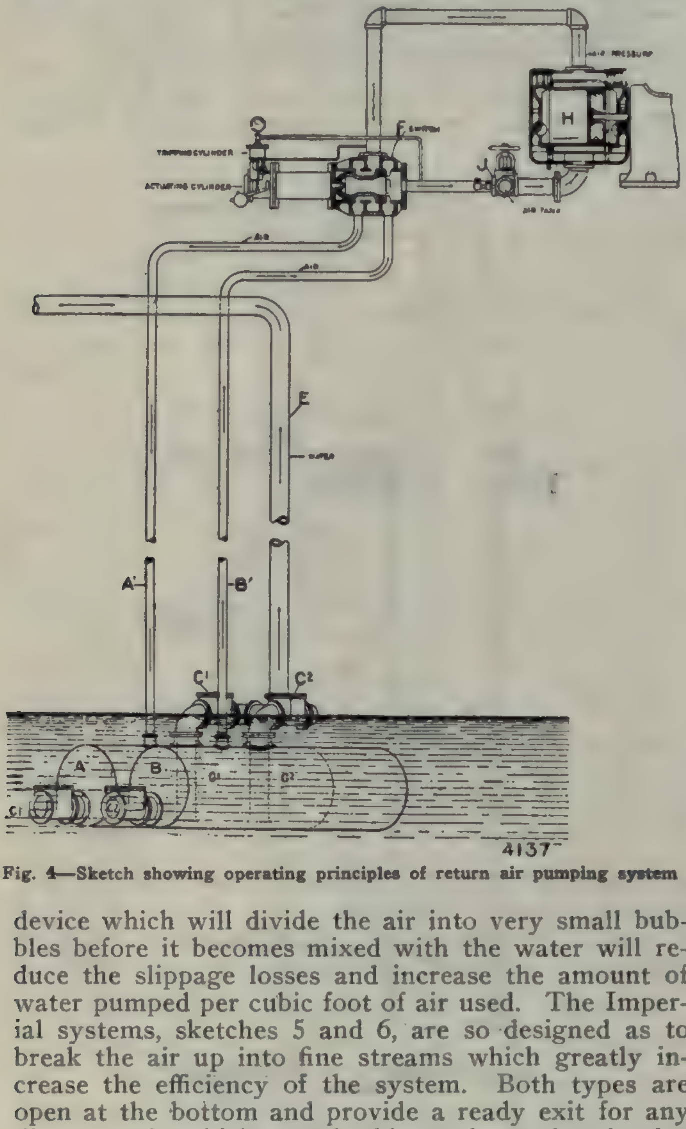


Fig. 4—Sketch showing operating principles of return air pumping system

### Limitations and Handicaps of the Air Lift System

The quantity of water which may be handled by an air lift pumping system is limited only by the capacity of the wells to furnish water. With a properly designed piping system the loss of power in the transmission is trifling, and compares favorably with any other system of power transmission. With a given size of pipe it varies as the distance, that is, the loss in 2 miles will be twice that in 1 mile, etc.

The air lift pump being entirely automatic in operation there is no objection to having the source of water supply at a considerable distance from the power house. One central power plant supplies air to over 375 wells in a large southwestern oil field, over 10 square miles of country and through 40 miles of pipe.

Where deep water pumps are used for very high lifts, more or less trouble is usually experienced through the breakage of rods and valves and the entire installation operates at low efficiency through the increased friction and leakage of plungers and valves, and the care and attention which they require. There are, however, many air lift installations in use where the lifts vary from 600 to 1200 feet pressures of from 1/4 to 1/3 of a pound per foot of actual lift.

The air lift has received much unjust criticism at the hands of those who have installed it as a sort of last resort under conditions that have seriously handicapped it, whereas deep well pumping equipment has usually been given every advantage. The fact that deep well pumps will either work as designed or not at all, and that no matter how poorly an air lift system is installed, it will give some kind of results, has probably had a great deal to do with the prejudice which has existed against it in the minds of some prospective users.

### Modern Practice

Those who have made an unbiased investigation of the possibilities of this method of pumping, have long been aware of its reliability, low installation and maintenance costs, and have generally acknowledged that by its use it was possible to obtain a greater quantity of water from a given well than by any other means. Within the last few years the high state of perfection to which the air compressor has been brought and the improved methods of introducing the air into the eduction pipe or water column, as well as the better proportioning of the pipes themselves, has so increased the efficiency of a properly designed air lift as to allow its favorable comparison with any other type of deep well pumping system at present available.

### Air Lift Definitions

The static head is the distance from the level of the water in the well to the well head or ground level when the well is not being pumped.

The drop is the distance which the water in the well recedes when the well is delivering a certain definite quantity of water.

The elevation is the distance above the well head to which it is desired to deliver the water.

The lift consists of the static head plus the drop and elevation.

The submergence is the distance below the water level at which the air is admitted into the column and is either called starting or running submergence. The distance from the point where the air is admitted to the water column to the point of final discharge of the mixture of air and water is considered as 100%. Thus a 70% submergence means a 30% lift, or a 30% submergence a 70% lift, the amount and percentage of the submergence depending directly upon the height of the lift. These terms are illustrated graphically in Figure 3.

### Operation of the Modern Air Lift

In the modern air lift constant streams of air and water are mingled, the air being broken up into minute bubbles and distributed through the water, resulting in a constant discharge with a minimum of slippage. The eduction pipe must be kept filled with air and water and if the pipe in use is too large for the amount of water available a larger quantity of air must be used in order to keep up the velocity. The amount of water carried per square inch in the eduction depends on the lift and percentage of submergence. A 3 inch pipe will be of ample size to use to pump 100 gallons per minute with a 100 foot lift and 60% submergence, while a 3-½ inch pipe would be required in order to raise the same amount of water with the same life and a submergence of only 40%. In other words the submergence regulates the air pressure, and the higher the air is compressed the greater are its expansive qualities, hence a smaller quantity of air will be required to do the work, and it will occupy less room in the eduction pipe owing to its higher velocity. With little submergence and consequent low air pressure and velocity a larger amount of air must be used and more of the eduction pipe filled with air on account of the lower velocity.

For best results the eduction pipe should have as smooth a surface as possible and places where the air may eddy, such as the ends of the screwed joints in ordinary iron pipes, should be eliminated wherever possible, as these increase the friction slippage between the air and the water. The piping from the compressor to the point where the air is introduced into the well should receive careful attention. Every bit of power used to compress the air to a higher pressure in order to overcome friction is wasteful, and the extra first cost in installing large air pipes is compensated for by the saving in power consumption which, although it may be very slight, is continuous day in and day out.

### Some Notable Installations of the Air Lift

The only really successful objection to the air lift in the past has been that it was not efficient and as stated in the foregoing, if reasonable care is used in selecting and installing the equipment, the air lift will be found to be equal if not superior to any other method of raising water from deep wells. That this is true is borne out by the experience of some of the largest users of the system in the United States and Canada such as: The city of Kitchener, Ont., The Canadian Pacific Railway, Angus Shops, Warden King Company, Dawes Brewery, Ottawa Dairy Company, The cities of Plainfield and Asbury Park, New Jersey, Mexico City, Jefferson Ice Company, Chicago, United States Finishing Company, Pawtucket, Rhode Island, etc.

### Cost of Installations

When considering the purchase of a new machine or piece of equipment one of the first points to receive attention is the cost of installation. In this respect the cost of small air lift installations including wells of up to 400 gallons per minute in capacity will be the same or slightly greater than with other methods. For installations of 400 to 800 gallons per minute the cost is about equal with a decided advantage in favor of the air lift for capacities beyond this. One of the reasons for the lower first cost of the larger capacities of air lift pumping systems is that each well yields more water than is obtainable by any other means, thus decreasing the number of wells to be bored.

### Cost of Maintenance and Flexibility

The maintenance cost of the air lift is in marked contrast to that of the ordinary pump in which a number of working parts are directly exposed to the liquid being pumped and which requires the continual packing and renewing of valves, etc. The air lift pump, when once installed, stays down the well, and nothing comes in contact with the water except the air and the piping. Its efficiency is continuous and the conditions which prevail at the time the installation is tested out are usually those under which it continually operates.

The only machinery required is the compressor which may be located in the power house or in any convenient place and as a modern compressor is enclosed, self oiling, and automatic in operation, it requires a minimum of attention, and this need not be given by a man of great skill.

In the operation of the air lift it is sometimes desirable to carry the water along the ground horizontally or at an angle, with a subsequent lift to a tank or reservoir, and unless the system has been carefully designed, more or less trouble will occur and the system will operate at low efficiency. When these conditions prevail, it is necessary to submerge the air nozzle below the water level to a distance having a large ratio to the actual total lift.

### Boosters

To meet these conditions efficiently, the water from the air lift may be discharged into a tank or pond and then raised by ordinary steam or centrifugal pumps to the desired height and place of storage or consumption. The use of steam or power driven pumps for the purpose, however, detracts to a large extent from the automatic features of the system as a whole, and it is, therefore, much better to use what is known as the air lift booster.

The object of an air lift booster is to force a solid stream of water horizontally or vertically through a pipe or system of pipes from an air lift pump, the air being separated from the water in the booster and its pressure made use of to force the water horizontally or to a higher level.

As shown in Figure 5 the booster is placed directly over the well head so that the air lift pump discharges directly into it. The mixed air and water as discharged by the air lift is separated in the booster and the pressure utilized in doing the work. The booster is very simple in operation, the amount of air in the booster being controlled by the water level. An automatic valve is so aranged that as the water rises the valve is closed and a pressure built up in the booster, and as the water falls this valve opens and allows the air to escape from the booster directly to the atmosphere or to the intake of the compressor as may be desired.

If the air is returned to the intake of the compressor, it is necessary to pass it through a moisture trap so as to dry it as much as possible before it reaches the compressor.

The most valuable feature in the use of the booster is the advantage gained by being able to deliver the water to the place desired without the installation and maintenance costs of power driven pumping equipment, and the fact that, as with the air lift pump itself, the whole system retains its feature of automatic operation to a high degree.

### Summary

The air lift steadily improves the well and increases the flow, and sand, solids, or semi-solids in the water have no detrimental effect on the pump or its operation. With the ordinary pump of the reciprocating or rotary types, unless specially designed, this matter has to be prevented from entering the pump by means of screens, which become clogged in time and require time and trouble to remove and clean. The air lift by drawing out the sand and sludge, enlarges the water bearing cavities of the well and so increases its flow.

The air lift is thoroughly reliable, reasonoble in first cost, economical to maintain and will obtain all of the water a well is capable of yielding and often increases this yield, and when the yearly over-all costs are compared with those of any other type of pumping equipment, the balance is in favor of the air lift. This fact alone should commend the air lift to the careful attention of anyone who is confronted with the problem of securing an abundant supply of pure water.

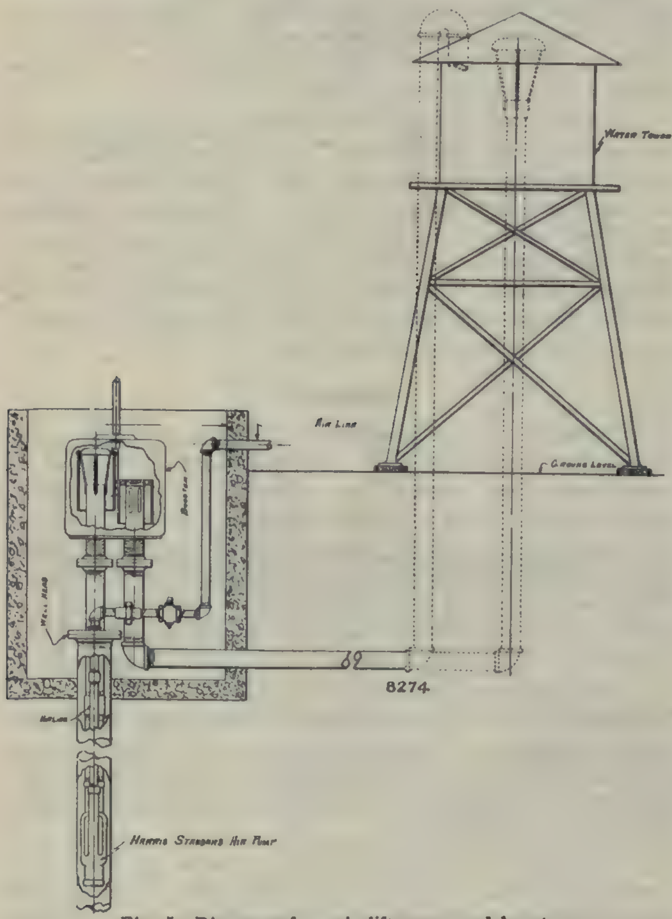


Fig. 5—Diagram of an air lift pump and booster

### Displacement Pumps

The displacement pump is one of the simplest types of power driven pumping machinery ever produced, consisting essentially of two barrels or cylinders, which are filled and discharged alternately, the charge in each cylinder being directly displaced by the admission of the necessary volume of air through an automatically controlled valve. The principal requirement is that the tanks be submerged from 5 to 6 feet, which unfortunately it is not always possible to arrange for. The cylinders are filled without the use of any power and are discharged with a minimum of loss through friction. There is no packing or other portions of the pump subject to leakage and it is not affected by dirt, grit or semi-solids in the water.

Displacement pumps start and stop automatically and only use air in exact proportion to the volume of water discharged. Due to their extreme simplicity they require practically no repairs and little or no attention; many pumps in fact are operated for weeks without anyone bothering to look after them. They are usually built in sizes having capacities of up to 3000 gallons per minute and the height to which they will lift water is only limited by the air pressure used. By the arrangement of several pumps in series, it is entirely feasible to raise liquids to almost any height without the use of excessive air pressure.

### Application

Up to the present the displacement pump has been more widely used in mine work than in other industries, for such work as pumping out the water which often gathers in sumps, dips and entries, or wherever it is possible to completely submerge the pump. Where total submergence was possible they have proved very effective for discharging automatically seepage or leakage water in subways and tunnels and in the basements of factories and in industrial plants, its utter indifference to dirt and grit making it particularly valuable for such work.

In a slightly modified form the displacement pump has been applied to handling and elevating pulp stock, marl, paint, acids, alkalies and other heavy semi-fluids. Where the material handled is of a very corrosive nature it is customary to locate the air valve so that it is not brought into direct contact with the liquid or exposed to any vapours which may arise from it. For transferring pulp from one tank to another and for sewage ejection, the results obtained with these pumps have been very promising when conditions were favorable.

The displacement pump when used alone or in connection with an air lift pump will often solve the problem of obtaining a reliable water supply. The pump may be submerged in a river, lake or small pond, or in a reservoir filled with water from artesian wells by an air lift. In this case one compressor of the proper capacity will supply both the air lift and the displacement pump, making a system that is simple, efficient and very economical in both installation and attendance costs.

### The Return Air Pumping System

To overcome some of the disadvantages of the ordinary displacement pump and still retain the large capacity, simplicity and convenience of this method of pumping, the Ingersoll-Rand company brought out their return air pumping system. It may be termed an expansion displacement pump and its principal advantage over the older forms of displacement pumps lies in the fact that the potential energy of expansion in the displacing air volume is profitably applied instead of being wasted.

### Essential Requirements of the System

The return air pumping system is a complete system of pumping in which the air, after doing its work in one tank, is returned to the compressor to do some work in the other tank. It consists of a closed circuit in which by a regular pre-arranged cycle of operations it is possible to compress, expand and recompress and re-expand one volume of air indefinitely, each cycle of compression and expansion corresponding with a discharge of the liquid in one of the pump tanks.

The essential requirements of the system are an air compressor driven by steam, electricity or other convenient form of power; a reversing switch located near the compressor; two air pipe lines leading from the compressor through the switch to one of the pump tanks; also two pump tanks, which are either submerged in the liquid to be pumped or arranged so as to be filled by syphonic action. Provision is made for automatically replacing the air which may be lost in each cycle by leakage or absorption in the system or by operation of the switch.

### Operating Principle

The principle of the return air system is very simple, compressed air being led to a tank full of the fluid to be pumped, forcing it out through a suitable discharge pipe, through which its return is prevented by the use of a check valve. The air which has displaced the fluid from the tank is expanded back through the air line and switch, compressor intake valves, compressor cylinder and discharge valves, until equilibrium is restored throughout the system which then contains a charge of air at a certain pressure above that of the aamosphere. This equalizing operation takes but a short time during which the compressor operates at no load as the pressure is balanced on each side of the piston. When equilibrium has been attained the compressor again takes on its load, compressing the air in the second tank and drawing air through its intake from the first tank and pipe line which are already under high presure. As the pressure in the second tank is increased the fluid is discharged, and as pressure in the first tank is decreased the fluid enters.

The sequence of operations will be readily understood by reference to the lettered diagram in Figure 4; A and B are twin displacement tanks, completely submerged in the liquid to be raised, or, where this is not possible, filled by syphonic action. A′ and B′ are the two air pipe lines containing the discharge check valves C1 and C2 which prevent the return of the liquid ejected. Check valves C1′ and C2′ prevent the discharge of the fluid through the inlet. E is the discharge pipe common to both tanks. The automatic switch F controls the pumping cycle. G1 and G2 are the tank risers. H is the air cylinder of the compressor, while J is the automatic compensating valve which keeps the system supplied with the proper amount of air. As shown in the diagram, the compressor H is withdrawing the air from the tank B and compressing it in tank A. At the same time the fluid is entering tank B through the check valve C2′ while it is being ejected from tank A through its riser G1, check C and discharge pipe E. The apparatus is so arranged that when the tank B is completely filled, the switch F will be automatically operated exactly reversing the cycle of operation, by allowing the air at full pressure in the tank A to expand through the switch F and the compressor H into the pipe line B′ and the tank B forcing the fluid out of the latter. The moment that the pressure in the tank A is reduced to a point where it is lower than the hydraulic head of the liquid in which it is submerged or from which it is siphoned, the fluid will enter the tank through the check valve C′ until the tank is completely filled, at which point the reversing switch F will again operate automatically, reversing the conditions for another cycle.

### Automatic Switches

There are two types of automatic switches which can be used with this system, the relative merits of each for a given installation depending on local conditions. The simplest type is simply an air operated piston valve similar to that used on rock drills, each throw of the valve corresponding with the filling of one tank. An auxiliary valve is thrown by atmospheric pressure on one end, overcoming a partial vacuum on the other end, the difference in pressure being secured as explained in the following: The system is so installed that normally the tanks are filled by gravity; thus the tank is filled with fluid as the air goes out, without any suction action. Thus when a tank is level full of water or other liquid the air in the pipe connected to that tank is normally at atmospheric pressure, and as the compressor continues to withdraw air from this pipe, a slight vacuum is created. The reversing switch being connected to this pipe, the partial vacuum on one end of the auxiliary valve is overcome by full atmospheric pressure on the operation of the auxiliary valve, which in turn throws the main valve. A recurrence of this action on the filling of the second tank reverses the switch for another cycle. Where circumstances require the tanks to be filled by siphonic action, the switch may be so adjusted that it throws only when a higher vacuum is reached, thus making provision for an additional lift on the intake.

The second type of switch is well adapted for use with submerged tanks, and is known as the difference-in-pressure switch. It is arranged so as to automatically reverse when the pressure in the tank being filled reaches the oint where it is completely filled and there is no further necessity for reducing the air pressure. This arrangement confines the cycle of operation between the pressure necessary for pumping, and some return pressure above the atmosphere, thus keeping the ratio of compression within the lowest limits and making it economical for use with submerged tanks. The question as to which of these switches should be used for a given installation will depend on local conditions, and in makig a decision the purchaser should be governed by the advice and experience of the maker of the equipment.

### Compensating for Leakage

Where the first mentioned switch is in use, there will always be a slight amount of air lost through the operation of the switch. Leakage and absorption of the air by the water will also consume a small amount of air. To automatically compensate for these losses is the function of the compensating valve J, which is simply an atmospheric check valve which opens when a partial vacuum is created on its inner face. This will occur at a point in the cycle where the pressure drops below the permissible vacuum, thus indicating that the charge in the system is insufficient. A globe valve placed just outside the valve J is adjusted to admit just the right amount of air to maintain the operative conditions at the highest efficiency. Losses through absorption, leakage and the operation of the switch are compensated for, when the difference-in-pressure switch is used, by a small auxiliary air pump or compressor called a booster, which automatically makes up for the losses in the system.

### Starting the Return Air System

On starting, the system operates during the first cycle as an ordinary displacement pump, the compressor H taking its air at atmospheric pressure through the valve J and its accompanying globe valve which is, of course, fully opened on starting. As soon as the required pressure is built up in the system, the check valve closes automatically and the cycle of compression and expansion begins, and the globe valve is adjusted to admit the right quantity of air.

### Efficiency of the System

The return air system under normal conditions will show an average efficiency of about 55 per cent; some installations have, however, shown 60 per cent and never, even under very unfavourable conditions, has an efficiency of less than 40 per cent been shown. These figures represent the actual ratio of water raised to the I. H. P. of the compressor steam cylinder with all losses included. It will not be difficult, with these percentages as a basis, to figure the actual power cost in a given case, in which all local conditions are definitely known, such as the price of coal per ton and the total cost of boiler feed water. When careful consideration is given to these figures, it will be readily seen that from the standpoint of fuel economy alone, the return air system is well worth consideration.

### Application of the System

The return air pumping system, being of very simple construction, is readily taken care of by the average engineer and is easily installed. Once it is put into operation it is entirely automatic, yet may be instantly and completely controlled from the compressor room, uo matter how far away it may be. As there are no stuffing boxes, glands, pistons, or plungers in contact with the fluid to be pumped, and no delicate parts liable to become corroded and abraded, the system has been widely adopted for use in handling chemical solutions in salt works, bleacheries, tanneries, etc., and for the transferring of semi-fluids in pulp mills, cement mills, glass factories, etc., as well as for the elevation of sewage in industrial plants and small towns. Excessive submergence only tends to improve the efficiency of the system, and no oil is required at the pump.

## Annual Meeting, Association of Professional Engineers of British Columbia

The Association of Professional Engineers of B. C. held its second annual meeting on Saturday, Dec. 3, at the Hotel Vancouver, with a large attendance of the membership. Seeing that the Association has only been actively working for one year, a great deal of importance attached to this first anniversary meeting. After the activities of the Association during 1921 had been thoroughly discussed and approved by the meeting, election of officers proceeded, when Mr. D. O. Lewis was elected president, for 1922, Mr. J. M. Turnbull, vice-president, and Messrs. A. E. Foreman, G. A. Walkem, H. L. Johnston, J. Muirhead members of the council. Major W. G. Swan, automatically becomes a member of the Council for 1922 as last past president. A very hearty vote of thanks was extended to Major Swan and the retiring council for their activities and the work accomplished during the year. A special vote of thanks was extended to Capt. E. A. Wheatley as a mark of appreciation for the manner in which he had carried on his duties as secretary.

Morning and afternoon sessions of the meeting were held, and a very enjoyable luncheon was held in the hotel dining room between the sessions. Mr. G. S. Hanes, M. L. A. for North Vancouver in the provincial legislature, was the chief guest. Mr. Hanes, in the course of a brief speech remarked that he felt his duties as a member of the Association of Engineers might in the last analysis prove to be of as much importance as his duties as a member of the legislature. He congratulated the Association on the successful year's work and on the strength of their organization and the success of the annual meeting. The secretary announced that the attendance of members at the meeting was one hundred and fifty.

William George Swan, D. S. O., B. A. Sc., born in Ontario, came to B. C. in 1910 after being divisional engineer and terminal engineer for the Canadian Northern Railway, saw much service in France, is now chief engineer for the Vancouver Harbor Commissioners.

John Moncrieff Turnbull, B. A. Sc., M. C. M. I. vice-president for 1922, born in Montreal and educated at McGill University, came to British Columbia in 1897, where after holding important positions in the mining world, he became professor of mining and head of the mining department, University of British Columbia.

The Association of Professional Engineers of British Columbia

# Load Requirements in Building Codes Have Wide Variation

## Examination of Three Hundred Municipal Building Regulations Shows Absence of Any Uniformity in Permitted Loadings—Waste Caused by These Differences in Standards

By RICHARD G. KIMBELL
Architectural and Building Code Bureau, National Lumber Manufacturers' Association

Of fourteen hundred and seventy-eight cities of over five thousand population in the United States, only four hundred and ten or 27 per cent of them, so far as has been determined, have a building code.

By persistent effort, a library of the codes of some three hundred cities has been accumulated. A careful study of them reveals some decidedly interesting and significant facts. This article will discuss only the live load requirements in the various codes. As the codes of cities located in close proximity to a larger city generally have similar requirements to those of the larger city, a group of sixty-five widely scattered cities of over twenty-five thousand population was taken as being representative and their codes examined to determine if the suspicion of a wide variation was founded on fact or surmise.

An effort was made to place the various loading assumptions under the headings found in these sixty-five codes. That effort brought out the first of the variations of this topic, there being so many divisions or groupings and so different as to make this impossible. Therefore, a group of occupancies believed to be representative was chosen and the load requirements tabulated thereunder. This, of course meant the omitting of some of the requirements that were minor divisions under one group heading, and others that were separate and distinct. One code in addition to providing load assumptions for the various portions of different buildings, went even further and gave loads for the assembly halls of theatres, schools, hospitals, dance halls, hotels, etc., which were at variance with the loads under the other headings for the same buildings.

### Variations in Dwelling House Requirements

Possibly the most interesting of the variations brought out in this tabulation, and one of greatest significance to our home owners and builders, referred to dwelling loads. These range from 30 to 80 pounds per square for the first floor, 30 to 50 pounds per square foot for the second floor and 20 to 40 pounds for the attic. Is there rhyme or reason in this? Is a dwelling in city A liable to greater loads than one in city B? Generally the spans of joists are limited by deflection to prevent plaster cracking. On that basis a 2 x 10 will carry a 30 pound load over a 16 ft. 3 in. span, while the same timber will carry an 80 pound load for only 13 ft. 0 in. Thus poor Jones in city A, where they require dwelling house floors constructed to accommodate a live load of 80 pounds per square foot, must use a 2 in. x 12 in. joist for a 15.8 ft. span while Brown in city B, who only has to provide for a 30 lb. load, uses a 2 in. x 10 in. joist for a span 7 in. greater than Jones', with less lumber for each of his floor supporting members than Jones used. Is this fair or justifiable? Is there sense in requiring Jones to buy more material for the same purpose than Brown, making his building cost more, causing an investment on which he will never secure a return? If the 30 lb. load requirement is safe, what a great economic waste and needless hardship is caused by an 80 lb. requirement. If, however, a floor built to accommodate 80 lbs. per sq. ft. is the absolute minimum, for safety and stability, this man Brown who builds to accommodate only 30 lbs. has erected a house of cards and created a hazard to the occupants of his building.

The following is a summary in tabular of the occupancies and the ranges of the live loads for the sixty-five cities; the figures indicating range of loads in pounds per square foot:

Dwellings, 1st floor, 30 to 80; 2nd floor, 30 to 50; attic, 20 to 40.

Tenements and apartments, 1st floor, 30 to 80 above, 30 to 50.

Stores, light merchandise, 1st floor, 75 to 150; above, 100 to 125.

Stores, heavy merchandise, 1st floor, 120 to 250; above, 200.

Warehouse, heavy, 150 to 250; light, 100 to 150.

Factories, heavy, 150 to 250; light, 100 to 150.

Roofs, pitch 20° or less, 20 to 50; pitch of more than 20°, 15 to 50.

Assembly halls, moveable seats, 80 to 125; fixed seats, 50 to 125; drill, 100 to 250; dances, 100 to 200; rooms, 40 to 120.

Schools, corridors, 60 to 125; assembly, 75 to 125.

Office buildings, 40 to 100.

Public buildings, 50 to 150.

Stairways and fire escapes, general, 60 to 125; assembly, 100 to 125.

Garages, public, 70 to 175; private, 40 to 125.

Grandstands, 80 to 125.

Hotels, rooms, 30 to 75; corridors, 60 to 125.

Hospitals, rooms, 30 to 100; corridors, 80 to 100.

Sidewalks, 150 to 500.

### No Reason for Variation in Roof Loads

The loads for roofs having a pitch of more than 20 degrees from the horizontal, vary from 15 lbs. to 50 lbs. per square foot. Oh yes, someone remarks, that variation is accounted for by the fact that a city with a 50 lb. load provides for a snow load in addition to the other loads, while the city with a 15 lb. load is probably in the south where they have no snow loads. That would seem logical, but is, however, not borne out by the facts. Although southern cities as a rule have lower roof load requirements than the northern cities, this does not hold true in all cases. One city with a 15 lb. load is within two hundred miles of a city with a 50 lb. load, and both are in the northern New England States. Indeed, the 15 lb. load city is about one hundred and fifty miles north of the city having the greater load. Roof loads should undoubtedly vary according to climatic conditions, but the particular instance cited shows clearly that in many cases, they are not within reason. Such variations in cities where conditions are similar proves the majority of our building laws are based neither on logic nor judgment.

Further, what of the variations of from 30 to 100 per cent for all industrial buildings? And what about the great variance in the quantity of materials required in this type of structure? This question, however, hardly needs discussion, as a practical engineer will readily realize the loss, waste and inconvenience of such different standards, and when brought to his attention, will generally make an effort to right the wrong. With the prevailing ordinances should his practice be wide and diversified, and distributed over a considerable territory, he must have in his possession the building laws of all the cities where he erects structures to be able to meet the local requirements in his designing.

Furthermore, such variations prohibit and prevent standardization in the design of various structural units otherwise entirely possible.

The opnion is held by some that where the requirements as to floor loads are low, the allowable unit stresses for structural materials are correspondingly low, and where the live loads are high, the attending stress values are also high,—thus in a way balancing the variations so that approximately the same amount of material would be used in both localities for a building of the same character. This, however, is not true in the majority of cases. A city with high load requirements may have the same allowable unit stresses for materials as a city with low loads and vice versa. This has been verified by our examination of the some three hundred codes in our library. The variations in the allowable stresses and their effects will be presented in a subsequent article.

# Montreal General Contractors Ass'n Hold Annual Meeting

The annual meeting of the Montreal General Contractors' Association was held on December 16th at the Builders' Exchange, Montreal.

Mr. Douglas Bremner, of Bremner-Norris & Co., Ltd., who presided, outlined the activities of the Association during the past year. He stated that the Association has dealt with such questions as the wages of mechanics, Dominion Sales Tax as applied to the building industry, city water taxes on steam engines, the scale of charges for equipment, and a code of ethics and practice. He was glad to say that there had been a complete absence of trouble in their trades,—indeed, he might say that although wages have been reduced, the building industry was the only one in which there had been no labor trouble. Several factors have contributed to this condition, but the main one was that the members of the Association had stuck together and had shown loyal co-operation. There was still plenty of work for the Association, and he mentioned the following which required their earnest attention—workmens' compensation acts for the provinces of Quebec and Ontario, employers' liability in the Province of Quebec, and a code of ethics and practice.

The financial statement was submitted by Mr. H. C. Johnstone, honorary secretary-treasurer, and on the motion of Mr. John Quinlan, and seconded by Mr. R. McLean, the report was adopted. A vote of thanks was also passed to the officers for their economical management of the funds.

The question of the foundation work of the new Court House, Notre Dame Street, was discussed. It was pointed out that the Association had no knowledge of the intended awarding of the contract until the work had been let by the Department of Public Works, of which the Honorable A. Galipeault is Minister. It was further pointed out that there are many building contractors in the Province of Quebec who are large ratepayers in the province and in their respective cities, who are quite competent to handle to the complete satisfaction of the highest authorities work of this character. They have apparently been excluded from sharing in what provincial buildings are coming forward at this time, and the general ratepayer, of whom the building interests form no inconsiderable part, has been prevented from sharing in the benefits to be secured by the whole community from open competition. The Association have written Mr. Galipeault asking that in future tenders for all construction work undertaken by his department be called for openly and publicly.

The Association also complained that in regard to the repairs of the old Montreal jail, to make it suitable for the headquarter of the Quebec Liquor Commission, requests made to Mr. Galipeault to have the plans and specifications for the work sent to the exchange had been ignored. The result was the contractors were not in a position to tender.

Mr. Douglas Bremner was re-elected president, the other members of the executive being Messrs. H. C. Johnstone, of H. C. Johnstone & Co.; R. McLean, of the James Shearer Co., Ltd.; E. G. M. Cape, of E. G. M. Cape & Co., Ltd.; and V. H. Moore, of the Purdy & Henderson Co., Ltd. These officers will meet and select a vice-president and honorary secretary-treasurer. Mr. D. K. Trotter was re-appointed secretary-treasurer.

The annual meeting of the Builders' Exchange will be held the fourth Monday in January. The nominating committee of the Exchange recommend as officers for 1922, Mr. K. D. Church as president, Mr. J. E. Walsh as honorary treasurer, and A. Plamondon as honorary secretary.

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### New Salesroom for Gas Company

The Consumers' Gas Company of Toronto have announced the opening of a new salesroom at 55-57 Adelaide St. E. They claim this is one of the finest display rooms in Canada.

# Promotion of World Trade

### The Work of the British Commercial Intelligence System is Described at the Montreal Branch of the E.I.C.

The functions of the British Government Commercial Intelligence System were described by Mr. G. T. Milne at the meeting of the Montreal branch of the Engineering Institute of Canada on December 15. Mr. Milne, who is the Senior British Trade Commissioner for Canada and Newfoundland, has had a wide experience in several parts of the world, including South America, South Africa, Australia and Havana. He outlined in general terms two duties of his department and also referred to the service given to Canadian traders.

For many years British manufacturers had no particular reason for a Commercial Intelligence Department owing to Britain's outstanding position as an industrial nation. With the development of highly organized nations, like the United States and Germany, the position changed and a commercial intelligence system became necessary. This was in effect a form of government subsidy, which had in late years been extended both to particular trades and to individuals. About twenty years ago the Government established the commercial intelligence branch, a later development being the appointment of trade commissioners in Canada, Australia, South Africa and New Zealand.

With regard to the foreign countries, British commercial interests were for years in the hands of consular representatives, but these had a multitude of duties not connected with trade and, naturally, trade interests suffered. The government, therefore, appointed Commercial Attaches who supplied the Board of Trade with a very large amount of information as to trade possibilities. The Trade Commissioners now number fourteen, three being in Canada—in Montreal, Toronto and Winnipeg. The department in charge was known as the Department of Overseas Trade, and was a joint department of the Board of Trade and the Foreign Office, with its own minister.

It was sometimes said that the Commercial Intelligence Department of the other countries excelled that of Great Britain. It must, however, be recognized that the British people were an individualistic people and that there was a latent distrust of Government activities in relation to trade. This was not so pronounced as in earlier days, it being recognized that there were occasions on which Government officials could give valuable help. The Canadian Government had an extensive commercial intelligence department and from personal experience we know that the department was doing excellent work. That department would probably be extended; it seemed probable that Canada, which was becoming more of a manufacturing country, would be in the position of requiring more men who could give valuable information as to export trade.

The work of a Trade Commissioner embraced almost every known activity.

The officers were not experts and could only rely upon the goodwill of the merchants in the various countries; after having served in different parts of the world he could say that he had always received the assistance he had asked for. Consuls had been described as honourable spies—that described the position of Trade Commissioners. In Montreal they had many inquiries, particularly as to India. The services of the Commissioner's office were paid for by Great Britain. The trade in the Old Country had been backed up by Government officials, but in the same way as that of Canada, by men who had the enterprise to promote it by individual effort.

Mr. Milne also dealt with the British Industries Fair, which he hoped would be largely attended by Canadians, and with the British Government export credit scheme.

At the conclusion of Mr. Milne's speech, the annual meeting of the Montreal branch was held. The report stated that the membership of 904 increased 25 per cent. over that of the previous year and the attendance at the meetings was so large that an enlargement of the accommodation was under consideration.

The balance on hand is $56. A long discussion on the financial position was followed by a resolution suggesting voluntary donations, not exceeding $5.00, to form the nucleus of a reserve fund.

Mr. J. A. Duchastel, was elected chairman of the branch; Mr. John T. Farmer, vice-chairman; and Messrs. R. Bickerdike, P. B. Motley and C. J. Desbaillets members of the committee.

# C.P.R. Depot, Moose Jaw

### Handsome Station Recently Opened—Has Every Modern Facility for Handling Terminal Business

On November 20 the handsome new Canadian Pacific Railway depot was put into commission at Moose Jaw, Sask., and the passenger terminal business of the company at this point will be handled from now on through the modern facilities which are contained in the new depot. The new station occupies a unique position among the terminals of the company, having been declared by railway men to be the most modern and up-to-the-minute passenger terminal in any city of this size on the North American continent and a credit to any city with twice the population.

The building is as nearly fireproof as engineering science can devise, being of brick and stone with reinforced concrete floors and copper roof. The building is surmounted by a clock tower built of Tyndall stone.

The waiting room is fifty feet wide by one hundred and twenty-four feet long, with vaulted ceiling. The walls of the waiting room are of grey tapestry brick, with wainscoting of glazed tile. The door and window trimmings are of ornamental tile.

The feature of the waiting room is the fact that the entrance to the tracks is directly in line with the front exit on to Main Street. The building was designed with the idea of keeping the traffic entirely separate from the waiting room. To the right of the entrance from the street is the ticket office.

#### Concourse Unobstructed

The concourse for the travelling public is unobstructed. With the ticket office on the right are information bureau, parcel check room and baggage room, to the left of the concourse is the news stand, behind it the section of the waiting room reserved for the convenience of passengers awaiting the departure of trains. Opening off the waiting room are two large rest rooms, one for ladies and the other for gentlemen, each equipped with lavatories and washrooms finished in marble.

To the south of the waiting-room is the new dining-hall which is in keeping with the rest of the station, being equipped with a modern kitchen equal to any on the company's system.

The floors of the waiting-room and rest-rooms are of heavy brown tile, each piece being laid separately.

Much of the material, such as the glazed tile for the interior of the waiting-room, was brought from Great Britain.

The exit to the tracks will when the work is completed be by way of stairs and subway, which will be 20 feet wide, with stairway leading up to each track. No person but a ticket holder will be allowed through the exit to the tracks, the only entrance to the track level from the station being that from the station-master's office.

The construction of the building was commenced in August, 1920, by the Carter, Halls, Aldinger Company, of Winnipeg. The work was proceeded with very rapidly, and the station was enclosed to allow the workmen to continue during the whole of last winter. It had been planned to open the station in June of this year, but delays in the arrival of materials from the old country made it necessary to postpone the opening.

## Association for Advancement of Science

The following is the program for the meeting of Section M of the American Association for the Advancement of Science, which is meeting in Toronto this week. Section M includes the Society for the Promotion of Engineering Education.

**Wednesday, December 28.**

1. "Ice Formation and Prevention with Special Reference to Frazil and Anchor Ice," (Illustrated by Moving Pictures), Mr. John Murphy, Electrical Engineer, Department of Railways and Canals, Ottawa, Canada.
2. "Engineering Standardization", Mr. R. J. Durley, Secretary, Canadian Engineering Standards Association, Ottawa, Canada.
3. "Fifty Years of Progress in Mining in Canada", Mr. John E. Hardman, Consulting Mining Engineer, Montreal, Canada.

Afternoon Session

1. "Recent Progress in Metal Mining in Ontario" (Illustrated by Moving Pictures), Mr. Thos. W. Gibson, Deputy Minister of Mines, Ontario.
2. "Gold Mining in Ontario", (Illustrated by Moving Pictures), Mr. A. F. Brigham, General Manager, the Hollinger Mine, Ontario.
3. "Nickel Mining and Smelting", (Illustrated by Moving Pictures), Mr. W. L. Dethloff, Chief Engineer, the Mond Nickel Company, Ontario.

**Thursday, December 29.**

Morning Session

1. "Toronto Harbour Development", Mr. E. L. Cousins, Chief Engineer and Manager, Toronto Harbour Commission.
2. "Industrial Research", Mr. R. A. Ross, Chairman Honorary Advisory Council for Scientific and Industrial Research, Canada.
3. "Railway Development in Canada", Mr. H. K. Wicksteed, formerly Chief Locating Engineer, Canadian Northern Railway.

Afternoon Session

1. "Exploration for Oil in Western Canada", Mr. A. M. McQueen, Vice-President, Imperial Oil Company, Toronto.
2. "Coal Mining in Alberta", Mr. James McEvoy, Consulting Coal Mining Engineer, Toronto.
3. "Oil Resources of the Valley of the Mackenzie River", Mr. D. B. Dowling, Geological Survey of Canada.
4. "Hydro-Electric Development in Ontario", (Illustrated by Moving Pictures), Sir Adam Beck, Chairman, Hydro-Electric Power Commission of Ontario.

**Friday, December 30.**

"Relation of Industry and the Practicing Engineer to Engineering Education"—Addresses by R. C. Harris, Commissioner of Works, Toronto, Prof. Chas.

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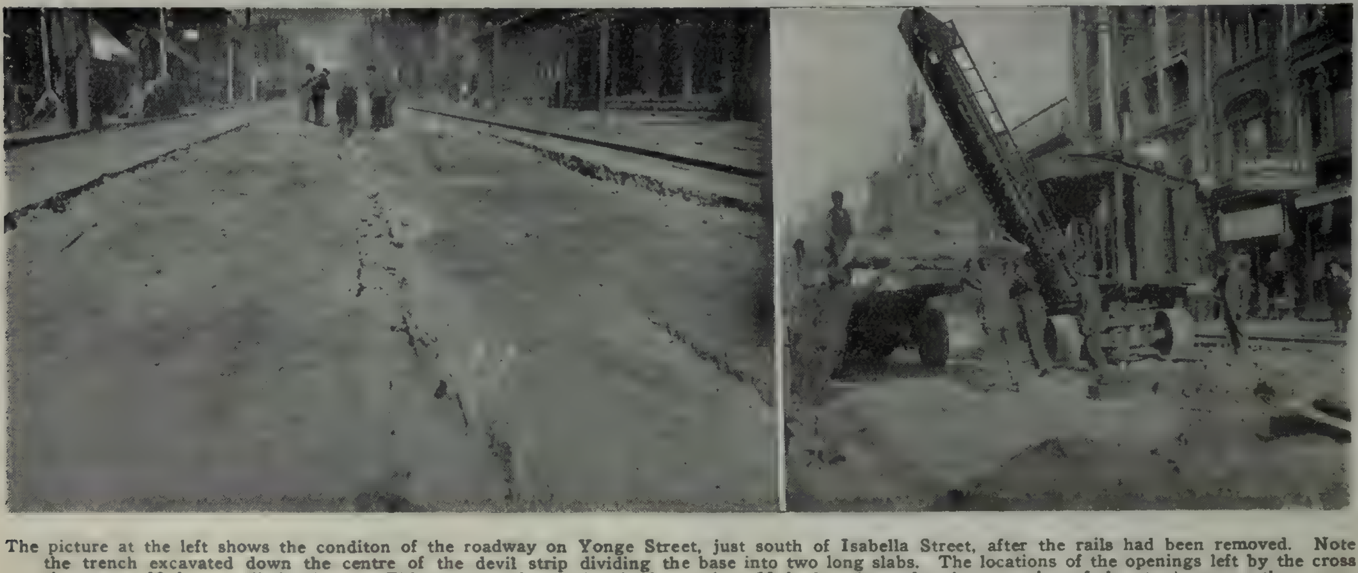
# Rehabilitation of Toronto's Street Railway System



The picture at the left shows the conditon of the roadway on Yonge Street, just south of Isabella Street, after the rails had been removed. Note the trench excavated down the centre of the devil strip dividing the base into two long slabs. The locations of the openings left by the cross ties, every 10 ft., are dimly shown. This concrete foundation broke up into 10 ft. lengths under the operation of the steam crane; these were loaded on trucks, as shown in the right hand picture.

Dec 28, 1921

# How Construction Costs Have Varied During Past Seven Years

**How much does it cost to build a two-storey house containing six rooms and bath? Daniel Crawford, Jr., of Philadelphia, states that the present cost is $6,676, as against $2,969 in 1914 and $8,346 in 1920, and supports his contention with figures based on an operation in Philadelphia covering 100 houses. The figures which follow were presented by Crawford at the National Conference of the Construction Industries held recently in Philadelphia under the auspices of the Philadelphia Chamber of Commerce and the National Federation of Construction Industries.**

| | 1914 | 1920 | 1921 |
|---|---|---|---|
| Ground | $ 500.00 | $ 600.00 | $ 600.00 |

### STREET IMPROVEMENTS

| | 1914 | 1920 | 1921 |
|---|---|---|---|
| Sewer | $ 22.50 | $ 60.00 | $ 60.00 |
| Water pipe | 15.00 | 30.00 | 30.00 |
| Curb (plain) | 6.00 | 16.50 | 16.50 |
| Cartway paving | 25.00 | 90.57 | 90.57 |
| | $ 68.50 | $ 197.07 | $ 197.07 |

### GENERAL CONDITIONS

| | 1914 | 1920 | 1921 |
|---|---|---|---|
| Plans | $ 1.00 | $ 2.00 | $ 2.00 |
| Survey | 3.50 | 5.00 | 5.00 |
| Building permits and affidavits | 5.00 | 7.50 | 7.50 |
| Water permit (brick and stone) | 1.80 | 1.80 | 1.80 |
| Electric service | ....... | ....... | ....... |
| Gas service | ....... | 4.00 | 4.00 |
| Fire insurance on building materials | .10 | .10 | .10 |
| Fire insurance on buildings | 1.60 | 3.87 | 2.58 |
| Plant and tools | 5.00 | 15.00 | 12.00 |
| Sales expense | 64.00 | 176.00 | 144.00 |
| Advertising | 32.00 | 88.00 | 72.00 |
| Office expense | 29.40 | 78.60 | 65.50 |
| Compensation insurance | ....... | 7.93 | 6.80 |
| Taxes | 11.25 | 25.00 | 77.45 |
| Interest | 101.25 | 263.00 | 219.40 |
| Title company's charges | 69.75 | 150.25 | 123.75 |
| Deed—acknowledging revenue & rec'd'g | 4.00 | 8.50 | 5.00 |
| Expense—Placing first mortgage | 20.00 | 220.00 | 108.00 |
| Expense—Placing second mortgage | 23.00 | 278.00 | 125.00 |
| Supervision | 18.00 | 36.00 | 36.00 |
| Supplies | 5.00 | 15.00 | 12.00 |
| | $ 395.65 | $1,445.55 | $1,036.18 |

### CONSTRUCTION

| | 1914 | 1920 | 1921 |
|---|---|---|---|
| Excavation | $ 40.95 | $ 99.45 | $ 93.60 |
| Stone masonry | 145.54 | 408.70 | 354.42 |
| Brick masonry | 226.25 | 703.67 | 659.71 |
| Rough carpentry | 255.42 | 955.41 | 555.67 |
| Finish carpentry | 266.00 | 850.00 | 610.00 |
| Plastering | 104.61 | 355.04 | 269.42 |
| Cement work | 83.10 | 258.54 | 198.76 |
| Cut stone | 7.70 | 16.00 | 16.00 |
| Structural steel | 11.80 | 48.47 | 35.63 |
| Roofing and spouting | 50.00 | 120.00 | 110.00 |
| Plumbing and gas fitting | 167.00 | 545.00 | 442.00 |
| Heating | 166.00 | 440.00 | 368.00 |
| Electric wiring | 30.00 | 81.25 | 65.00 |
| Stairwork | 37.50 | 166.00 | 125.00 |
| Labor—general | 25.00 | 50.00 | 50.00 |
| Tile work | 5.50 | 12.00 | 9.90 |
| Iron fence and clothes poles | 17.00 | 30.00 | 25.00 |
| Sheet metal work | 35.00 | 105.00 | 85.00 |
| Cabinet work | 22.70 | 56.00 | 49.00 |
| Hardware—finish | 11.00 | 35.09 | 32.00 |
| Hardware—rough | 11.00 | 33.00 | 24.00 |
| Painting and glazing | 100.00 | 225.00 | 215.00 |
| Art glass | 8.75 | 15.00 | 15.00 |
| Range and connection | 21.50 | 55.00 | 65.00 |
| Gas water heater and connection | 12.00 | 35.00 | 26.00 |
| Parquetry floor | 48.60 | 143.75 | 129.60 |
| Flue lining and crocks | 2.10 | 8.35 | 8.35 |
| Grading—general | 3.15 | 5.63 | 6.30 |
| Paperhanging and decorating | 42.75 | 110.00 | 106.88 |
| Lighting fixtures | 44.25 | 90.00 | 85.00 |
| Sodding and seeding | 2.43 | 4.85 | 4.05 |
| Numbering houses | .65 | 1.00 | 1.00 |
| | $2,005.15 | $6,103.64 | $4,842.79 |

### SUMMARY

| | 1914 | 1920 | 1921 |
|---|---|---|---|
| Ground | $ 500.00 | $ 600.00 | $ 600.00 |
| Street improvements | 68.50 | 197.07 | 197.07 |
| General conditions | 395.65 | 1,445.55 | 1,036.18 |
| Construction | 2,003.15 | 6,103.64 | 4,842.79 |
| | $2,969.30 | $8,346.26 | $6,676.04 |
| Sale price | 3,200.00 | 8,800.00 | 7,200.00 |
| First mortgage value | 2,000.00 | 4,400.00 | 3,600.00 |
| Second mortgage value | 700.00 | 2,500.00 | 2,000.00 |

### RATES FOR LABOR USED IN COMPILING ESTIMATES

| | 1914 Per Hour | 1920 Per Hour | 1921 Per Hour |
|---|---|---|---|
| Common labor | $0.17½ | $0.50 | $0.40 |
| Carpenters | .40 | 1.12½ | 1.00 |
| Carpenters' helpers | .20 | .60 | .50 |
| Plasterers | .50 | 1.25 | 1.25 |
| Plasterers' helpers | .35 | 1.10 | 1.10 |
| Bricklayers | .50 | 1.30 | 1.30 |
| Bricklayers' helpers | .35 | 1.10 | 1.10 |
| Stone masons | .45 | 1.30 | 1.30 |
| Painters | .40 | 1.00 | 1.00 |
| Roofers | .40 | 1.10 | 1.10 |
| Roofers' helpers | .25 | .70 | .85 |
| Cement finishers | .50 | 1.30 | 1.00 |
| Cement laborers | .20 | .60 | .60 |
| Tile setters | .65 | 1.00 | 1.00 |
| Tile setters' helpers | .40 | .56 | .68¾ |
| Plumbers | .44 | 1.15 | 1.15 |
| Plumbers' helpers | .20 | .75 | .75 |
| Steamfitters | .36 | 1.10 | 1.10 |
| Steamfitters' helpers | .24 | .75 | .75 |

### COST OF MATERIAL

| | 1914 | 1920 | 1921 |
|---|---|---|---|
| Foundation stone, per perch | $ 1.40 | $ 4.00 | $ 3.00 |
| Bricks, per M. | 7.00 | 20.00 | 18.00 |
| Cement, per bbl. | 1.55 | 5.25 | 2.63 |
| Rough lumber, per M. ft. | 20.00 | 70.00 | 46.00 |
| Flooring, No. 1 spruce, per M. ft. | 30.00 | 80.00 | 60.00 |
| Lath, 4 in., per M. ft. | 3.00 | 20.00 | 9.50 |
| Builders' lime, per bu. | .25 | .70 | .64 |
| Calcine plaster, per bbl. | 2.00 | 6.25 | 6.25 |
| Sand, per ton | 1.30 | 2.96 | 2.30 |
| Fibre, per bu. | .25 | .35 | .35 |
| Structural steel, per cwt. | 1.40 | 5.75 | 4.00 |
| Tin, per box | 8.20 | 22.00 | 22.50 |
| Felt, per ton | 30.00 | 110.00 | 85.00 |
| Pitch, per cwt. | .70 | 2.00 | 2.10 |
| Nails, per keg | 3.00 | 7.50 | 4.75 |
| Sash cord, per hank | .55 | 1.25 | .85 |
| Tile floors, per sq. ft. | .30 | 1.00 | .82½ |

### SUB-CONTRACTS SHOWN BY PERCENTAGE OF INCREASE (ABOVE 1914)

| | 1914 | 1920 | 1921 |
|---|---|---|---|
| Hardware (finish) | Unity | 218 | 190 |
| Plumbing | Unity | 226 | 168 |
| Heating | Unity | 165 | 122 |
| Painting | Unity | 125 | 115 |
| Paperhanging | Unity | 157 | 150 |
| Parquet floors | Unity | 195 | 167 |
| Roofing | Unity | 140 | 120 |
| Sheet metal work | Unity | 200 | 150 |
| Electric wiring | Unity | 170 | 117 |
| Millwork | Unity | 215 | 121 |
| Plastering | Unity | 268 | 158 |
| Gas ranges | Unity | 200 | 200 |
| Excavations | Unity | 143 | 128 |
| Rough stone foundation walls | Unity | 208 | 170 |
| Face stone work | Unity | 126 | 90 |

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F. Scott, Yale University, President of the Society for the Promotion of Engineering Education, and others. A discussion of the type of engineering graduate now demanded, the character of the training he should receive and the character and training of instructors needed in engineering colleges.

"Engineering Education Versus Vocation Training"—Addresses by Dr. F. W. Merchant, Director of Industrial and Technical Education, Province of Ontario; Prof. Dugald C. Jackson, Massachusetts Institute of Technology, and others. Delimitation of respective fields of these types of training to be discussed.

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We are advised that the calling of tenders for the proposed incinerator plant in Chatham, Ont., is delayed pending the decision of the new city council as to the location of the plant.

# Uniformity of Contract Principles

## Engineers, Architects and Contractors Co-operate to Formulate a Universal Document—Standardization of Contract Relations Will Have Many Advantages

A memorandum submitted by the Associated General Contractors of America for consideration by a Joint Conference on Contracts

The need of a more uniform code of contract principles, which will establish a recognized practice for executing construction and build up a strong foundation of precedent, has, during the past few years, been widely recognized. Experience in war time construction especially emphasized such a need and has so clearly shown the advantages of uniform contractural obligations that their use is strongly advocated. This means of eliminating many difficulties of supervision that devolve upon the individual architect or engineer has already been employed by several professional societies, and their experience with standard contract forms covering individual classes of work has shown gratifying results. In the building industry, especially, where unlform contracts provisions enunciated by the American Institute of Architects are widely used, they have enabled the architect to save time in drafting his contracts and to avoid contractual entanglements. They have, moreover, removed many causes of misunderstanding between the contracting parties and have undoubtedly raised the standard of construction performance. In fact, the only criticism to be made of this standardization is that it has not yet been extended to all major classes of construction. Similar accomplishment is also attributed to the standard documents of the American Railway Engineering Association.

So far, the uniform documents have been drafted to establish the principles governing but an individual class of work such as buildings or railways and these different types of construction have been considered more or less independent of each other. Consequently we find in these documents some duplication of effort and certain variations in expression regulating similar performances. This variation, though not detrimental when considering only one of the individual types of work, it is a disadvantage when considered from the viewpoint of the public or from that of construction as a whole. All of the principles used in these various branches may be equally acceptable; yet, if three or four different stipulations govern the same sort of obligation, their force in establishing a recognized practice and adequate precedent is weakened If by agreement between the various societies which have placed in effect their respective standard documents this variation of the general business principles could be eliminated, the force of established practice would be greatly magnified. The value of such force in removing controversy over contract interpretation is generally accepted.

### General Principles Same in All Work

Another important feature, concerned in the general adoption of a uniform code of principles, becomes apparent when standardization in new fields is considered. If the whole body of technical men as represented by their societies will select the general principles applicable to all types of work, agree upon them and give them their approval, then the greater portion of the standardization process shall have been completed. After these main principles have been drafted, the special provisions complementary thereto and applicable only to the individual type of work can readily be determined. This drafting of special principles can be carried on by any group of engineers for the work in which they are engaged and, by such procedure, the process of establishing uniform practice would be expedited with great saving of duplicated effort.

There is not the wide divergence of principle among contracts for different types of work that is commonly supposed. A study of several hundred existing contract forms recently completed indicates that roughly two-thirds of the provisions contained in the agreement and general conditions of these documents are applicable to any type of construction and could readily be segregated into a universal contract form. If this were done, a great amount of friction between contracting parties, which might be termed "bona fide misunderstanding" and which may arise from either ambiguous phraseology or contravention of the common law, would certainly disappear.

Aside from any feature of contractnal relations, however, another aspect of uniform contract performance, involving the economics of a construction business, is worthy of consideration. Construction companies are steadily extending the scope of their operations to more than one type of work. Those companies which have built up efficient organizations, for instance in railroad work, find it advisable to enter highway, public works and other lines of construction. In fact, this tendency, together with the influence of trade organizations in the basic industries, which necessitates more co-operation between contractors, is consolidating the various branches of construction into a construction industry. This process, which is taking place throughout modern industry and which appears to be but a logical step in our industry evolution, naturally creates a need for more uniform contracting principles.

Morever, the work of estimating, administration and accounting is indirectly dependent upon contract provisions; and further development of these functions, with their resulting effects in stabilizing the industry, can be hastened by unifying the various codes of principles. This development is looked forward to with hope by all construction elements as a means of eliminating waste. The individual company finds it difficult to carry on its business under a different set of rules for each kind of project, and these companies are confident that if the main business principles were made standard for all work, having variation only where divergence is essential, they could give better construction service.

### Advantages of Standard Contract

Some professional men and some contractors are not yet sold on the idea of a standard contract, but those who have given the matter careful study agree that it offers many advantages, which under individual drafting of contracts cannot be obtained. Some of these advantages may be summarized under the following heads:

(1) Less expenditures and legal service.

(2) Less duplication of work in the professions.

(3) Elimination of dispute.

(4) Better safeguard for owners and increased public confidence.

(5) An improved standard of construction throughout the country.

These points, some of which have already been touched upon, are practically self-explanatory.

The most effective means of bringing about recognition of and compliance with the best construction practices appears to depend upon a segregation of general and special contract principles, placing those which pertain to work in a standard document. Such a primary document will convey to everyone the main governing principles of construction obligations, leaving to the secondary and complementary document the special stipulations. The first can be selected and approved by all of the technical societies,and the second can be drafted by those best able to speak for an individual field of construction. This work should be undertaken.

When the process of standardization has been carried out the field of construction contracts would then be covered by:

(1) The universal document for all work, preferably called "The Agreement;"

(2) Several sets of special principles one for each type of work, for example, one set for railways, another for building, another for waterworks and so on to the desired extent. These documents might preferably be designated "The General Conditions" of each type.

This Agreement, then, with the proper set of General Conditions, together with the plans and specifications, will form the Contract.

# Overhead in Construction Work

## Frequently Wholly or Partially Overlooked in Estimates—General and Contingent Overhead—Its Proportion is Greater Under Present Conditions of Handling Work

By M. J. REINHARDT*

In considering "Construction Overhead," the writer has seen fit to take two divisions of the overhead expense, which expense is so frequently oevrlooked in estimates, but which necessarily and surely enters into the cost of all construction work.

These two divisions are: First, the general overhead expense or that which is necessary for the maintaining of a construction organization to carry on such business; and second, the contingent overhead expense or that which is brought about by the above organization performing some specific construction operation or contract job. This first will naturally vary with the size of the organization or firm and with the scope of the construction field covered by it; the second will remain about the same for a given work, whether the firm employed is large or small, and is contingent in amount upon the work performed.

General overhead which is very small for certain small contract workers, runs into considerable proportions for firms organized to handle proficiently large undertakings.

### When General Overhead Is Negligible

Thus, two mechanics may contract to plaster a house at so much per yard for the labor, or to lay brick by the thousand, performing practically all the work themselves. While they may have to spend certain of their time in getting such work, so does the mechanic working by the day or by the hour, and, it may well be said, the general overhead expense for such individuals is practically nothing.

Gradually these same men, working as a firm, take on larger work or contracts where materials have to be purchased by them and where it is necessary for them to employ labor. They soon find the need of a bookkeeper, an office or place of business, and files and office equipment. Finally, a corps of estimators and detailers become necessary and they must have construction equipment and invested capital. As the firm expands and covers larger territory, branch offices are required in the locality where the work is being done, which means more clerical work at home, more analyzing of costs and more detail work in order to promptly purchase material on a larger scale and carry on their operations successfully. This expense is what the writer has termed general overhead and it includes such items as salaries and travelling expenses of men devoting their time to general supervision and to getting contracts, salaries of estimators and detailers and clerical help, office rent, insurance, interest paid out, taxes, reports and advertising, general depletion and obsolescence of equipment on hand, wire service, office supplies, etc. Should the above items total thirty thousand dollars expense per year for a firm doing one million dollars worth of business per year, this general overhead would amount to 3 per cent. of the gross income; and since the firm's source of revenue is obtained from compensation paid to it for performing construction work, it must necessarily be paid this item of 3 per cent. general overhead as an item of expense, in order to realize just compensation for the work performed.

### Contingent Overhead

In considering the second division or contingent overhead, this can best be analyzed by considering the items of expense which enters into a specific operation, for instance, a cubic yard of concrete in place in an average highway bridge such as is frequently awarded on a unit bid proposal by the engineer in charge. These items are:

| No. | Item | |
|---|---|---|
| 1 | Portland cement, 1½ bbls. at $2.80 ........ | $ 4.20 |
| 2 | Drayage on 6 sacks at 4c each ............ | .24 |
| 3 | Return of 6 empty sacks (and loss) ....... | .05 |

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*Before the Oklahoma chapter of the American Association of Engineers.

### *No.32*

## *Canada's Contractors—C. M. Morssen*

**Concrete is now so widely recognized as an intimate part of construction in all its phases, that it is scarcely realized that it is but a few years since its advent was hailed with considerable suspicion and distrust. The history of its introduction and constantly increasing usefulness is one of the romances of the engineering and construction industries. In view of the interesting history which the material has, it is with a peculiar pleasure that we present in this series a sketch of one of the first men to introduce reinforced concrete in the country—Charles Michrael Morssen, president of the Atlas Construction Co., Ltd., a well known Montreal engineering and contracting firm, specializing in reinforced concrete structures.**

**Mr. Morssen was born in Poland in 1872 and received his technical education at the Ecole Nationale des Ponts et Chaussees, in Paris. He came to Montreal in 1906 as engineer and superintendent of the Hennebique Construction Company. In the following year he was consulting engineer to Morssen and Company, but since then has been consulting engineer and president of the Atlas Construction Company, which was establishsed in 1908. Mr. Morssen has designed and erected some of the most important reinforced concrete buildings in and around Montreal, including the Southam Press Building, Bank of Toronto, Northern Electric Company's building, Berliner Gramophone Company's factory, St. Michael's Church, (which has a concrete dome 75 ft. in diameter.) He also designed, in collaboration with Professor E. Brown, and built and launched the first concrete ship in America, the "Concretia."**

**Mr. Morssen is a member of the Engineering Institute of Canada and the holder of the Gzowski medal awarded by that organization. His other affiliations include associate membership in the American Society of Civil Engineers and membership in the Polytechnical Society of Poland and the Association Amicales des Eleves des Ponts et Chaussees.**

Mr. C. M. Morssen

| | | |
|---|---|---|
| 4 | Crushed stone .84 yds. at $3.00 | 2.52 |
| 5 | Drayage on stoue .84 yds. at $1.00 | .84 |
| 6 | Sand .42 yds. at $2.50 | 1.05 |
| 7 | Drayage on sand .42 yds. at $1.00 | .42 |
| 8 | Water | .20 |
| 9 | Form lumber 100 ft. B. M. at $35.00 | 3.50 |
| 10 | Carpenters labor on forms, 100 ft. B. M. at $30 | 3.00 |
| 11 | Hardware (nails, wire, etc.) | .20 |
| 12 | Fuel, oil, etc. | .08 |
| 13 | Labor for mixing and placing | 3.00 |
| | Material and labor cost | $19.30 |
| 14 | Freight on equipment | .40 |
| 15 | Plant set up | .50 |
| 16 | Rental on equipment | .20 |
| 17 | Liability insurance | .25 |
| 18 | Bond premium, 1½% of total cost | .36 |
| | Contingent overhead | $ 1.71 |
| 19 | General overhead 3% of total cost | .72 |
| | Contractor's cost | $21.73 |
| 20 | Contractor's compensation 10% of contractor's cost | 2.17 |
| 21 | Total | $23.90 |

The first thirteen items represent the cost of labor and material in the common usage of the terms, while the next five items, fourteen to eighteen inclusive, are those items which the writer termed contingent overhead. In this instance they are charges for getting machinery and equipment to the place where the work is to be done, placing the equipment in position to do the work, the wear and tear and maintenance on equipment, the liability insurance which is the employer's insurance against the responsibility imposed upon him by law to take care of injured employees or the injured public, and last bond premium which most construction operations carry to protect the owner against loss or default on the part of the contractor.

These are all items of expense which enter into the cost of the operation or work, and cost about the same whether the construction firm be large or small so long as it has the facilities and ability to perform in the regular way; and while they are items of expense entirely apart from labor and material actually put into the structure, they may best be termed contingent overhead expense.

Such contingent overhead expense may be very limited or almost negligible under some local or ideal conditions and may be so heavy in some exceptional cases as to exceed the cost of all other items combined, such as that encountered in contracting to furnish and drive a bent or two of piling in an isolated location penetrating a difficult material, or contracting to surface the floor of a bridge with sheet asphalt in an isolated location. In either case it is readily seen that the transportation of equipment, together with that of a few necessary skilled mechanics, might easily double in total cost the average unit cost for

# Is that Chimney Safe?

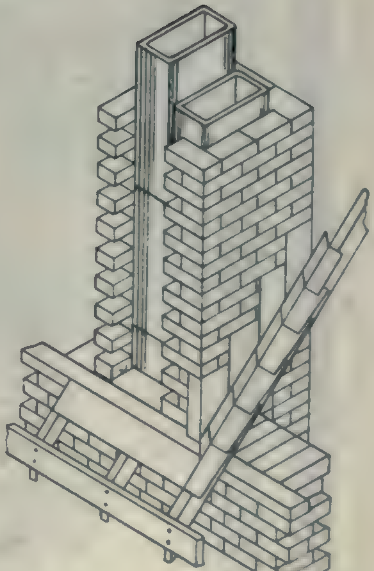
OFFICIAL statistics place Ontario's fire losses for 1920 at $4.70 per capita. The total exceeds $11,000,000 of which 4% is directly and over 10% more indirectly traceable to faulty chimneys.

Facts like these are indisputable proof of the need for fireproof chimneys. Brick and stone of themselves are not entirely safe. Intense heat, flames and fumes will in time cause disintegration in such chimneys unless they are lined with Vitrified Clay Flue Linings, a material essentially fitted for the purpose.

Vitrified Clay Flue Lining provides a smooth, uniform interior, improves the draft and is easy to keep clean. It is totally unaffected by gas, smoke, fumes or heat. It absolutely prevents flames or sparks leaking through the chimney walls to attack woodwork or other inflammable building material.

Every chimney, whether in industrial or residential buildings, should be lined with this fireproof material. It gives protection far superior to fire insurance yet it is easy to obtain, simple to install and the additional cost is quite negligible.

Made in a complete range of shapes and sizes, Vitrified Clay Flue Lining is one of a group of Vitrified Clay products that are endorsed and recommended by architects, contractors and property owners everywhere.



*For full particulars and literature write to*
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*9 Wellington St. E., Toronto, Ont.*
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**VITRIFIED CLAY PIPE**

PERMANENT AS THE PYRAMIDS

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## WHY YOU SHOULD USE THEM

Because they are easier to instal than other devices, because they require no fittings or couplings and because no supports are necessary for their installation on upright pipes. They may be easily sealed and they fit all standard meters, saving time, money and annoyance.

These points should interest you and knowing that many other superintendents use them consistently, send to us for more information and a sample, We'll gladly send them.

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Renders it absolutely waterproof. Gives it a cleaner color and smoother surface. Prevents efflorescence. Makes it work with greater ease. Slightly increases its strength.

And remember—there is no extra labor expense. Simply add PUDLO Powder to the dry cement. It never deteriorates, never decays and never loses its waterproofing qualities. Stocked by—

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(Continued on page 8)

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**EAST ORANGE N.J.**
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**WONDER MIXERS**
**PURCHASED IN 1912**

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Barrett Company, Limited

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Dom. Tar & Chemical Co., Ltd.

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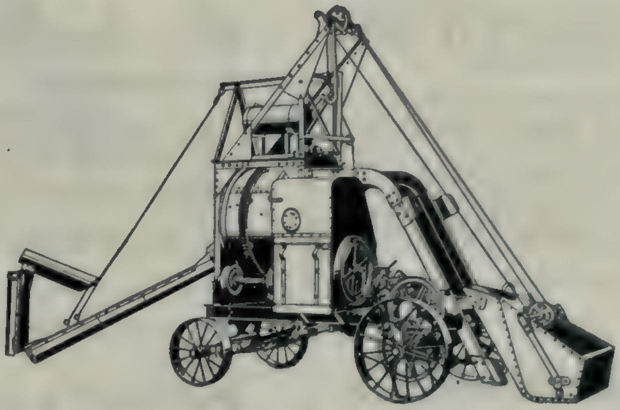

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## MODEL 4

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**Here's an interesting letter from a well known contracting firm.**

Ottawa Canada, Nov. 2nd 1921

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Replying to yours of Oct. 28th., would state that we are using every day the No. 4 Keystone purchased from you over two years ago, and, with the exception of a few small parts which are subjected to very hard wear and naturally have to be replaced from time to time, this machine is in as good condition as when it came out of the shop, although it has excavated over 150,000 square yards of grade, almost all of it heavy macadam.

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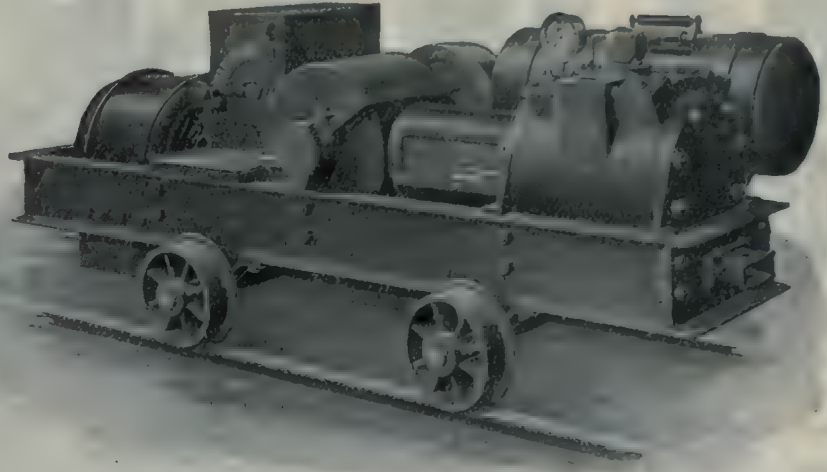

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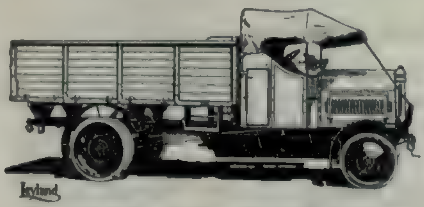
New York Office, 30 Church St.; Chicago Office, 616 Chamber of Commerce; Pittsburgh Office, Citizens National Bank Bldg.; Spokane Office, 612 Mohawk Block; Richmond Office, 712 Virginia Railway and Power Bldg.; Sioux City Office, 1811 Ross St.; Canada, east of Alberta, The General Supply Co. of Canada, 360 Sparks St., Ottawa and 5 Water St., Winnipeg, Man., Canada; 38 Toronto St., Toronto, Ont.; Ferguson Block, North Bay; McGill Bldg., Montreal, Que.; Empire Block, Moncton, N. B.

All Inquiries except from the United States and its possessions, Canada, Mexico and Cuba, should be taken up with the International Cement-Gun Company, 50 Maria Plaats, Utrecht, Holland.

---

## Last Seasons Work Finally Established Leylands Supremacy

"Performance counts"—and nowhere has this been more ably demonstrated than in the case of Leyland Trucks. They have become a familiar sight wherever construction work is in progress—due entirely to their performance **in Canada.** When a real hard job is to be handled, "Leyland" owners are asked to do it.



From 2 to 8 ton chassis, 3, 3½, 5 yards dump chassis, steam wagons, etc.

*Let us give you the facts*

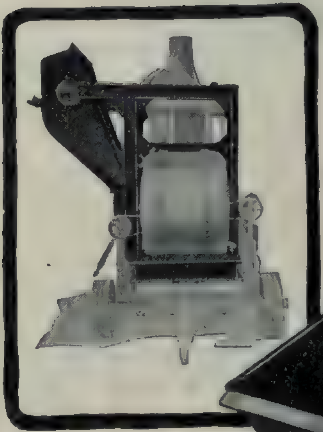
By Appointment to H.M. King George V

## Leyland Motors Limited

**110 DUCHESS ST., TORONTO, also at VANCOUVER**

# KOEHRING

**The Heavy Duty Mixer**



## Fortified Against the Greatest of Concrete Mixer Strains

WRENCHING strains of a loaded charging skip punish every part of a mixer, unless like the Koehring, the mixer has the super-strong main frame and super-structure, liberally cross-membered, joints machined to perfect fit—strongly gussetted and angle braced.

Koehring frame construction, together with the great saddle casting by which the charging skip is fastened to the frame by means of wide apart bearings which prevent side-sway—these are features of heavy duty construction which trouble proofs work, and insures long service life.

The special Koehring construction which permits the charging skip to pass between cable sheaves gives the skip the high angle charging position which chutes materials into drum in one swift, clean slide.

### *CAPACITIES*

***Heavy Duty Construction*** mixers 10, 14, 21, 28 cu. ft. mixed concrete, steam and gasoline. Ask for catalog—C

***Pavers:*** 10, 14, 21, 28 cu. ft. mixed concrete, spout, boom and bucket. Power discharge chute, multiplane traction, loading derrick, steam and gasoline. Ask for catalog—P

***Dandie Light Mixer*** 4 cu. ft. mixed concrete, gasoline, 7 cu. ft. mixed concrete, steam and gasoline. Low charging platform. Power charging skip or batch hopper, light duty hoist. Ask for catalog—D

**KOEHRING COMPANY · MILWAUKEE WISCONSIN**

**Canadian Representatives: Wilson-McGovern Ltd., Toronto, Ont. Eastern Equipment Co. Ltd., 234 Beaver Hall Hill, Montreal, Que.**

**Use
Structural
Steel**

**Use
Structural
Steel**

**Use
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Steel**

**Use
Structural
Steel**

The illustration shows an interesting view of the new Canadian Pacific Railway cantilever bridge at St. John, N. B.

The clear span is 450 feet and each anchor arm is 125 feet long, making the total length of the structure 700 feet. This is one more tribute to Structural Steel.

*Issued by the*
*STRUCTURAL STEEL ASSOCIATION*

# BOOKS
## for Engineers and Contractors

The following Books are Offered subject to Previous Sale:

"Hand Book of Hydraulics," by Horace Williams King. 1st edition published by McGraw-Hill Book Co., Inc. 424 pages. Price $3.50.

"Handbook of Building Construction," by George A. Hool and Nathan C. Johnson. Two volumes, (not sold separately), 1474 pages, illustrated. Published in 1920 by McGraw-Hill Book Company, Incorporated. Price $12.00.

"Highway Engineering" - (Rural Roads and Pavements) - by George R. Chatburn, A.M., C.E. recently published by John Wiley & Sons, Incorporated, 379 pages, illustrated, price $3.00.

History of Bridge Engineering, by Henry Gratton Tyrrell, C.E. 480 pages, illustrated. Price $4.00.

"Locks and Builders' Hardware," by Henry R. Towne. Published in 1904 by John Wiley & Sons. 1117 pages, illustrated. Price $1.50.

"Operation and Maintenance of Irrigation Systems," by S. T. Harding. First edition, published in 1917 by the McGraw-Hill Book Co. 271 pages, illustrated. Price $2.50.

"Practical Road Building," by Charles E. Foote. Just published by David McKay, 295 pages, illustrated. Price $1.50.

"Relief from Floods." The Fundamentals of Flood Prevention, Flood Protection and the means of determining proper remedies. By John W. Alvord and Charles B. Burdock. First edition, published in 1918 by McGraw-Hill Book Company, Inc. 175 pages, illustrated. Price $2.00.

"Steel Bridge Designing," by Melville B. Wells, C.E. Published by Myron C. Clark Publishing Company in 1913. 260 pages, illustrated. Price $2.00.

"The Engineering Index for 1920" - recently published by the American Society of Mechanical Engineers, 586 pages, price $6.00.

"The Location, Grading and Drainage of Highways," by Wilson G. Harger, C.E., 294 pages, illustrated. First edition, published by McGraw-Hill Book Co., Incorporated, 1921. Price $3.50.

"Use of Water in Irrigation," by Samuel Fortier. Published in 1915 by McGraw-Hill Book Company. 265 pages, illustrated. Price $2.00.

"Use of Water in Irrigation," by Samuel Fortier. Second edition. Published by McGraw-Hill Book Company, 1916. 325 pages, illustrated. Price $2.50.

"Water Purification," by Joseph Ellms. Published in 1917 by McGraw-Hill Book Company. 485 pages, illustrated. Price $5.00.

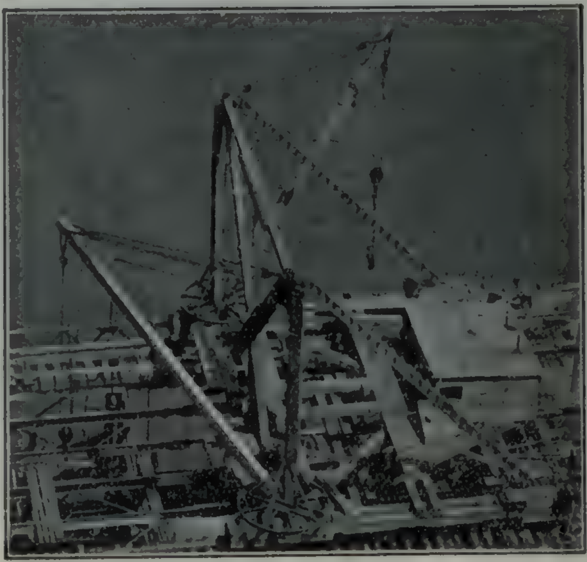
**Contract Record**
**347 Adelaide St. West, Toronto, Ont**

# CONTRACTORS

We have 25,000 feet of 2" LINE PIPE with LONG RECESSED COUPLINGS which we are selling at SPECIAL REDUCED PRICE—Saving of 25% guaranteed—Write us for particulars and price.

**ONTARIO PIPE & TUBE CO.**
234 LISTER BLDG. HAMILTON, ONT

# DERRICKS
# CRANES — HOISTS



AREO VIEW
Queenston Power House Installation Hydro Electric Commission

Derricks of large capacity — Our Hobby. Either steel or wood construction

**POLLARD MFG. CO., LTD.**
Niagara Fa'ls - Ontario

DEPARTMENT OF LABOUR
## BOILER INSPECTION NOTICE
*Excerpt from Regulations for the Construction and Inspection of Boilers*

*Section 133*

No Boiler which has been in use for two or more seasons shall be sold or exchanged for subsequent use as a Boiler unless it is accompanied by an inspection certificate issued by the Department within one year preceding the date of such sale or exchange. The allowable working pressure for such Boiler shall be determined by the Inspector from the formulæ contained in the regulations, with such deductions in pressure for depreciation as the Inspector's judgment shall dictate.

The travelling expenses in connection with the inspection of Boilers sold, exchanged or extensively repaired, must be paid by the owner or purchaser of such Boilers, together with the inspection fee of five dollars.

All communications should be addressed to the Steam Boiler Branch, Department of Labour, Spadina Crescent.

HON. W. R. ROLLO,
Minister of Labour.

D. M. MEDCALF, Chief Inspector of Steam Boilers.

"Domtar"

Bituminous Tar Binder

On the Hamilton-Queenston Highway, a "Domtar" Job.

AMONG the outstanding characteristics of "DOMTAR" are its lasting qualities of Adhesiveness as a Road Binder and its unexcelled waterproofing value as a Road Surfacing Material.

*For full information please address*

**Dominion Tar & Chemical Company, Limited**

**Head Office: 171 St. James St., Montreal** **Branch Office: 53 Yonge St., Toronto**

**SYDNEY, N. S.** **MONTREAL, P. Q.** **SAULT STE. MARIE, ONT.**

# Dominion Bridge Co., Limited

- Structural Steel Work,
- Steel Bridges,
- Steel Buildings,
- Tanks,
- Penstocks,
- Electric Cranes,
- Hand Power Cranes,
- Turntables
- Hydraulic Gates,
- Machine Work,

Structural shapes and plates carried in stock in all plants.

Write our nearest office for information or estimates.

We give the same prompt attention to either small or large enquiries.

***DOMINION BRIDGE CO., LIMITED***

***Main Office and Works — Lachine Locks, P. Q.***

**Branch Offices and Works - Toronto, Ottawa, Winnipeg.**

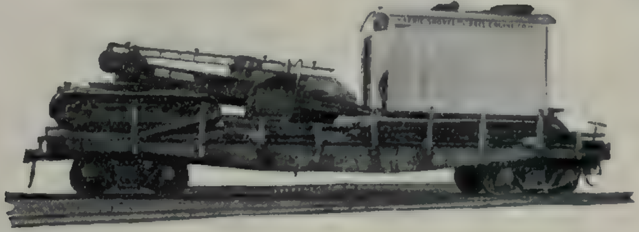
**Sales Offices - Montreal, Ottawa, Toronto, Winnipeg, Edmonton, Regina, Vancouver.**

# What you save

## When you buy a caterpillar type shovel that is

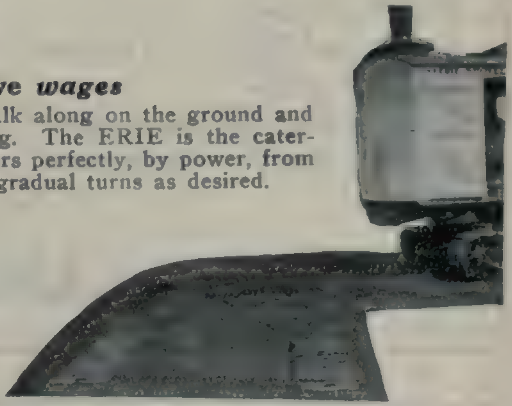
# UP-TO-DATE

*Here are a few of the ways in which the 1922 ERIE, caterpillar type, will increase your profits.*



### You save *assembling cost*

The ERIE loads on one flat-car with its caterpillar type mounting completely assembled. You save time and wages in erecting—and gain several extra working days. You save money whenever you have to load or unload the machine.



### You save *wages*

No man is needed to walk along on the ground and throw clutches for steering. The ERIE is the caterpillar type shovel that steers perfectly, by power, from the cab, making sharp or gradual turns as desired.

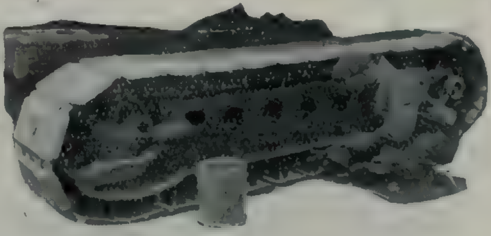
### You save *time* and *money* on every move

The caterpillar type ERIE, 1922 model, travels more than twice as fast as continuous tread shovels which run without lubrication. It climbs grades as steep as 30%. Walks right over a 10 x 12 in. timber placed in its path, with both treads.

### *Complete lubrication* saves you traveling time and upkeep costs

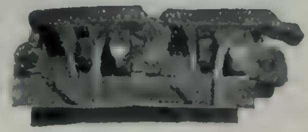
Here is one caterpillar type shovel that does not grind itself to pieces in a few miles of travel. Every roller and link connection is automatically lubricated, from internal oil reservoirs.

The operator fills all the reservoirs, once a month, in less than an hour.



### You save upkeep expense on tread links

The ERIE's tread links are of high carbon steel, practically indestructible. And it is never necessary to replace a link because of worn bearings. The ERIE'S link bearings are bushed, and the bushings are easily renewable when worn.



### You don't have to pay for repairs to broken chains

The ERIE'S rear sprockets are driven by hardened spur gears, entirely eliminating the breaking or stretching of driving chains. These are very common troubles of chain-driven shovels, especially when travelling over sticky material.

AND THIS DOESN'T TELL HALF THE STORY of the savings that you make with the 1922 caterpillar type Erie. **Get full details—write for Bulletin C-60.**

MORE THAN 100 ERIE SHOVELS AND CRANES, of the 1700 ERIES now in service, are equipped with the **ERIE** lubricated caterpillar type mounting (shown above).

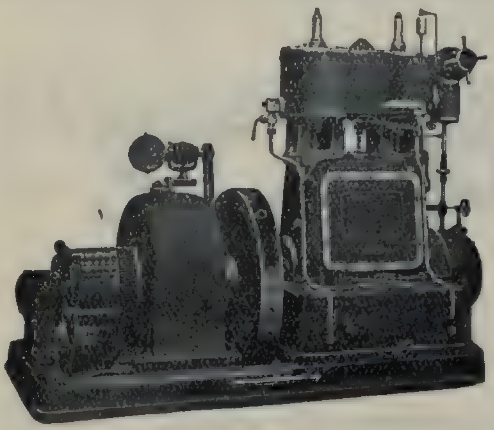
Many owners of caterpillar type **ERIES** have previously owned other makes of continuous-tread shovels—and they tell us that the ERIE has set a new standard both for efficiency of operation and for durability.

**BALL ENGINE CO., Erie, Pa., U.S.A.**
**Builders of ERIE Steam Shovels and Locomotive Cranes**

Branch Offices
New York · Boston
Pittsburgh Chicago
Representatives throughout the U. S. A.

**ERIE Revolving Shovels**

BALL



**Belliss Compound Engine with Generator**

## Belliss & Morcom, Limited
Birmingham, England

**Steam Engines**
**Steam and Exhaust Turbines**
**Diesel Engines**
**Air and Gas Compressors**
**Surface and Jet Condensers**

## Heenan & Froude, Ltd.
Worcester, England

**Air Coolers for Electric Generators or Transformers**

**Water Coolers for Internal Combustion Engines**

**Oil Coolers for Steel Quenching etc.**

**Duval's Metallic Packing**

**Semi-metallic Packing for Centrifugal Pumps**

***Agents—***

**LAURIE & LAMB, Board of Trade Bldg., MONTREAL**

# Dufferin Construction Co., Limited

*Engineers and Contractors*

**James Franceschini, President**

**304-5 Brass Building**
**Yonge and Adelaide Sts.**
**TORONTO**

**Phone Ad. 7387**
**Nights and Holidays**
**Kenwood 2862**

Before placing a contract, the parties responsible justly demand that the contractor give proof of his ability. Dufferin reputation is strengthened by a large number of important undertakings successfully completed. Herewith is shown a cut on the Toronto - Hamilton - Dundas Road, one of our recent jobs.

nut St.; wiring, Harris & Marson, 81-A Parkway Ave.; local phones, Automatic Telephones & Time Recorders, Ltd., 140 Victoria St.

**Verdun, Que.**

Additional contracts for school costing $100,000 for Verdun School Bd., are: Reinforced steel, Trussed Concrete Steel Co., 511 St. Catherine St. W., Montreal; plumbing and glazing, Wm. Noseworthy, 165 Egan St., Verdun; millwork, J. A. Davidson & Sons, Wellington St., Ottawa.

**Victoria, B.C.**

Plumbing and heating contracts for addition to hospital costing $107,986 for Royal Jubilee Hospital are awarded to Thacker & Holt, 620 Pandora Ave., at $62,108.

**Windsor, Ont.**

General contract for erection of technical school costing $450,000 for Windsor and Walkerville School Bds. is awarded to W. E. Wood & Co., 36 LaBelle Bldg., Windsor. D. J. Cameron and W. Ralston, architects, 5 Bartlett Bldg., Windsor. H. H. Angus, Mechanical Engr., Continental Life Bldg., Toronto.

## Business Buildings and Industrial Plants

**Annapolis Royal, N.S.**

J. G. Johnston, architect, Kentiville, N.S., is preparing plans for business block to cost $12,000 for W. S. Cumming, Annapolis Royal.

J. G. Johnston, architect, Kentiville, N.S., is preparing plans for furniture warehouses to cost $10,000 for Dargie & Son, Annapolis Royal.

**Hamilton, Ont.**

Plans are being prepared for restaurant and rooming house to cost $10,000 for S. Zadourin, 59 Princess St.

**Hanna, Alta.**

Hanna Bros., Hanna, Alta., will erect flour mill.

**London, Ont.**

R. H. Smith, 193 Wharncliffe Rd., is erecting a store costing $6,000 on Horton St.

**Ottawa, Ont.**

E. W. Marshall, Catherine and Bay Sts., plans erection of warehouse.

**Oyen, Alta.**

Erection of flour mill is contemplated by Farmers Milling Co., Oyen. Thos. Thomson, Oyen.

**Tecumseh, Ont.**

Omer Trepanier, Tecumseh, is building a hardware store.

**Toronto, Ont.**

D. C. Kay, 258 Ashdale Ave., is erecting 3 stores and apts. costing $8,000 each and will receive tenders for all sub trades.

E. Elliott, 77 Vermont Ave., will erect 2 stores costing $5,000 each.

S. Winesanker, 3335 Dundas St. W, contemplates erection of stores and apts. on Bloor St. W.

Plans are drawn for store and real estate office for A. Pearce, 1751 St. Clair W.

Erection of office bldg. northwest corner Bay and Adelaide Sts is contemplated. J. M. Lyle, architect, 230 Bloor St. W.

Building Supplies, Ltd., 1554 Danforth Ave., will remodel warehouse into store and warehouse.

Geo. Buschler, 173 Wright Ave., is building 4 stores and apts. at corner of Roncesvalles and West Marion.

E. Elliott, 77 Vermont Ave., is erecting 2 stores and apts. J. Hunt Stanford, architect, 67 Yonge St. Arcade.

**Welland, Ont**

Plans are being prepared for erection of addition to the Welland Machine & Foundries Co. plant for L. R. Weeks Engineering Co., Erie, Penn., U.S.A.

Erection of a cotton mill is contemplated by C. T. Grantham, 233 Division St.

### CONTRACTS AWARDED

**Dunnville, Ont.**

Steel contract for factory for Universal Cement Casket Co., Dunnville, is awarded to Standard Steel Construction Co., 29 Cross St., Welland, Ont.

**Halifax, N.S.**

Plumbing and heating contracts for residence costing $6,000 for F. D .Smith, care of general contractor, B. W. Wallace, 87 Preston St., are awarded to W. S. Craig, Upper Water St., and Longards, Ltd., 215 Hollis St.

**London, Ont.**

Plumbing contract for 10 bathrooms for remodelment of hotel costing $75,000 for W. S. Lashbrook, 293 Queens Ave., is placed with Wright-Teale Co., 60 Dundas St.

**Montreal, Que.**

Roofing contract for garage costing $30,000 for Martel Co., Ltd., 2454 Park Ave., is placed with Jos. Lamarche, 896 Drolet St.

Contracts for roofing, sheet meal and Kalamein doors for altering gatehouse and stores for warehouse costing $40,000 for Canadian Vickers, Ltd., 3072 Notre Dame St. E., are awarded to Douglas Bros. Co., Ltd., 19 St. Maurice St. Contract for asphalt flooring is placed with H. H. Sims, 42 St. Sacrement St.

General contract for erection of store and flats costing $14,000 for T. Lefebvre, 292 Clifton Ave., N.D.G., is awarded to A. Laquerre, 1647 Chabot St.

Jos. Lamarche, 896 Drolet St., has roofing contract for addition to garage costing $10,000 for Martel Co., Ltd., 2454 Park Ave.

General contract for extension to factory costing $13,000 for Carter White Lead Co. of Canada, Delorimier Ave., is placed with J. C. Johnston, 260 St. James St. Additional contracts are: Steel, Dominion Bridge Co., Ltd., Dominion Station, Lachine; millwork, R. MacFarlane Co., Ltd., 953 St. James St.; steel sash, Canadian Metal Windows & Steel Products, Ltd., 304 University St.

**Quebec, Que.**

General contract for erection of store costing $5,000 for E. Vincent, 232 St. John St., is awarded to Louis Careau, 127 Scott St.

**Three Rivers, Que.**

Geenral contract for erection of 2 stores and tenements for L. D. Ouellette, 53 St. Olivier St., is awarded to Lacroix, Villeneuve & Trottier, 148 Notre Dame St.

**Toronto, Ont.**

General contracts for 5 stores and apts. costing $14,000 each for W. W. Hiltz, 739 Broadview Ave., are: Glass, Hobbs Mfg. Co., Ltd., 121-179 Liberty St.; electrical, Nichol & Fagan, 111 Logan Ave.; heating, W. H. Miles & Co., 188 Dupont St.; plastering, J. Lansing, 435 Margueretta St.; painting, Johnston & Barth, 81 Cronyn Ave.; plumbing, W. Barrett, Milverton Blvd.

S. Shuter, 37 Greensides Ave., has general contract for erection of 2 stores and 3 apts. costing $25,000 for W. R. MacDonald, 177 Roncesvalles Ave. Plumbing and heating contracts are placed with Robert Jordan, 37 Hazelton Ave.

Roofing and painting contracts for addition and alterations to bank for Merchants Bank of Canada are awarded to Regan & Taylor, 1 Portland St., and Bavington Bros., 2032 Dundas St. W.

Additional contracts for alterations to office bldg. costing $160,000 for Toronto Hydro Electric and Toronto Transportation Cmsn., are: Heating and plumbing, W. G. Edge, Ltd., 47 Richmond St. E.; marble, Geo. Oakley & Son., Ltd., 287 Booth Ave.; structural steel, Dominion Bridge Co., Ltd., Imperial Life Bldg.

Contract for reinforced concrete for addition to factory costing $75,000 for Geo. Weston, Ltd., 134 Peter St., is awarded to Crescent Concrete Co., Confederation Life Bldg.

Contracts for addition to office bldg. costing $35,000 for Merchants Fire Insurance Co., 86 Adelaide St. W., are: Steel, Toronto Steel Construction Co., Ltd., 95 King St. E.; stone, Peerless Artificial Stone, Ltd.. Coxwell Ave.; glass, Toronto Plate Glass Importing Co., Ltd., 91 Don Roadway.

Additional contracts for store and apt. costing $10.000 for W. B. Isbester, 209 Westmoreland Ave., are: Roofing, City Roofing Co., 1036 St. Clarens Ave.; electrical, B. C. Taylor, 25 Marchmond Rd.; heating and plumbing, John W. Sheard, 80 Westmoreland Ave.; plastering, R. Cudmore, 26 Bird Ave.

Additional contracts for 3 stores and apts. costing $12,000 for S. Winesanker, 3040 Dundas St. W., are: Plumbing, O. S. Card, 267 Pacific Ave.; plastering, Watkins Bros., 24 Maher Ave.; electrical, W. F. Clarke, 62 Dundas St. E.; painting, Geo. Wineberg, 56 Brunswick Ave.; heating, S. Gilman, 208 Spadina Ave.

**Verdun, Que.**

Plumbing and heating contracts for store and apts costing $13,000 for H. Cuerrier, 1194 Wellington St., are awarded to Perrier & Freres, 202 Strathmore St., Verdun.

**Westmount, Que.**

Contracts for addition to bank for Royal Bank of Canada, are: Reinforced steel, Phoenix Bridge & Iron Works, Ltd., 83 Colborne St., Montreal; roofing and sheet metal, G. W. Reed & Co., 37 St. Antoine St., Montreal; plumbing and heating, Jno. Tweedle & Co., 163 Lagaucheteire St., Montreal; plastering, A. T. Clarke, 745 St. Catherine St. W., Montreal; stone, Canadian Benedict Stone Co.. Hague Ave., Montreal; int. trim, sash and doors, R. MacFarlane & Co., 953 St. James St., Montreal.

Contract for marble and tile for addition to bank costing $15,000 for Royal Bank of Canada is placed with Smith Marble & Construction Co., 145 Van Horne Ave, Montreal.

**Windsor, Ont.**

Electrical contract for market bldg. costing $150,000 for Winter & Little, 42 Pitt St. W., is awarded to McFarlane & Buchanan, 820 Assumption St., Windsor, instead of Iron City Engr. Co., Detroit, as was previously reported in error.

## Residences

**Fredericton, N.B.**

Areta Gerow, 313 Saunders St., will erect a residence on Lansdowne St.

# Tenders and Proposals

Official Notices by Governments, Municipalities, Architects and Engineers

## Notice to Contractors

PURSUANT to the requirements of the Canada Highways Act sealed tenders marked "Tender for Contract No. 652" will be received by the undersigned until **12 o'clock noon, Friday, January 20th, 1922**. for the grading and construction of a water-bound macadam base and other necessary work on the Provincial Highway at the junction of the Caledonia Road, Township of Barton and Concession Street, City of Hamilton.

Plans and specifications may be seen on and after Friday, December 30th, 1921. at the office of A. Timbroll, Resident Engineer, Simcoe, and at the office of the undersigned.

A marked cheque for $1,000.00 payable to the Minister of Public Works and Highways, or a Guaranty Company's bid bond must accompany each tender. A Guaranty Company's bond for 50% of the contract price will be required when the Contract is signed.

Bonds must be made on forms furnished by the Department.

The lowest or any tender not necessarily accepted.

W. A. McLean,
Deputy Minister of Highways.

Department of Public Highways, Ontario,
Toronto, December 23rd. 1921.

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## The Temiskaming and Northern Ontario Railway Commission

### Tenders for Railway Construction

SEALED TENDERS for the works (other than steel bridges) necessary to the complete construction of the Roadbed, ready for the ties and rails, and also the Track Laying Ballasting and Fencing, upon approximately Seventy miles of the Temiskaming and Northern Ontario Railway, extending from Cochrane to near New Post, will be received at the office of the Secretary-Treasurer of the Commission North Bay, until **twelve o'clock (noon) of the 9th day of January, 1922.**

On receipt of a request in writing, a copy of each of the following documents:-

Instructions to Bidders
Form of Tender
Specifications
Form of Contract

will be furnished to intending bidders at the office of the Chief Engineer of the Commission, North Bay, where plans and profiles pertaining to the work may be seen.

The right is reserved to reject any or all bids.

W. H. Maund,
Secretary-Treasurer

S. B. Clement,
Chief Engineer.
North Bay, Ontario, December 8th, 1921.

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## Business Chance

Sand & Gravel Pit, St. Catharines. City water on premises. Ideal location for cement block business. Large retail gravel business at present. Good buildings. Box 745, Contract Record. Toronto. 51-52

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### RATES

*20 cents per agate line (14 lines to the inch) Positions Wanted 1 cent per word per insertion. Positions Vacant 2 cents per word per insertion. Box number 10 cents extra. Advertisements for this Section must be received not later than noon on Tuesday to ensure insertion in Wednesday's issue.*

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## Tenders Wanted

SEALED TENDERS; Separate or Bulk addressed to T. J. Hepburn, Architect, Stratford, will be received up to Three O'Clock P.M. Tuesday January 3rd, 1922, for the different trades required for the erection of a four class room addition to Hamlet Ward School in the City of Stratford.

Plans and Specifications and all information may be obtained from the Architect.

The lowest or any tender not necessarily accepted.

A. W. Fisher,
Chairman of Bldg. Committee,
Stratford.

J. M. Riddle
Secretary School Board,
Stratford. 50-52

---

## FREE OF DUTY

### Locomotive Crane

20 ton McMyler eight wheel 50 ft. boom bucket operating full M.C.B., will travel over any Standard Gauge R.R. on its own trucks, used very little, condition perfect, ready for immediate shipment. This crane will be delivered in Canada free of duty, which means a big saving to purchaser.

Phone Wire Write

Send for our Bulletin of used equipment bargains.

CONTRACTOR'S MACHINERY & SUPPLY CO., 509 WABASH BLDG., PITTSBURGH, PA. 52 T.f.

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## Some One Wants to Buy

The equipment or machinery that you are not using.

It may be occupying valuable space in your yard or shop, collecting, dust, rust and hard knocks.

Sell it before "Depreciation" scraps it.

Use the Tender & For Sale Department. It helps others, let it help you.

---

### GOVERNMENT

## Construction Equipment

### FOR SALE

**At Toronto and Bowmanville, Ont. Quebec and Rimouski, P.Q**

Lists are being distributed for the disposal of surplus contractors' construction equipment, consisting of Gasoline and Steam TUGS, and LAUNCHES, SCOWS, SUCTION DREDGES complete, DERRICKS and Miscellaneous Supplies, also a SAW MILL.

Copies of these lists will be mailed on request.

## The Purchasing Commission of Canada

BOOTH BUILDING - OTTAWA

52

**Halifax, N.S.**

S. P. Dumaresq. architect, Royal Bank Bldg., is preparing plans for residence to cost $10,000 for Dr. G. R. Hennigar, Redden Bldg.

**London, Ont.**

F. B. Kilbourne, 9 Cove Rd., plans erections of residence costing $5,000.

Fred Deeley, 851 Princess Ave., is building a residence on Highland Ave.

**Montreal, Que.**

J. O. Nantel, 86 Old Orchard Ave., N.D.G., contemplates erection of residence.

J. M. Savignac, 1209 St. Denis St., plans erection of residence on West Broadway Ave.

Rockland Housing Co., Room 304 Bank of Nova Scotia Bldg., contemplate erecting 50 residences.

W. Quenneville, 496 St. Christophe St., is erecting a residence on Girouard Ave.

L. Mercier, 272 4th Ave., is erecting a residence costing $5,000.

Residence costing $5,000 is being erected by T. Bellehumeur, 1420 Mercier St.

C. Tisdale, 2865 5th Ave., is building a residence at cost of $8,000.

Residence costing $6,000 is being erected by E. Millette, 79 Masson St., Rosemount.

**Ottawa, Ont.**

Ottawa Housing Cmsn., 54 Rideau St., contemplate erecting residences at estimated cost of $150,000.

Ottawa Housing Cmsn., 54 Rideau St., contemplate expenditure of $150,000 for erection of residences.

Barrett Bros., 260 Catherine St., will erect 2 residences costing $5,000 each.

G. A. Young, 51 Spruce St., will erect a residence costing $5,000.

Fred Weeks, 40 Bellwood Ave., contemplates erecting a residence.

**Outremont, Que.**

Alex. Fortier, 23 Mount Royal Ave., contemplates erection of residence (6 flats) on Hutchison St.

J. T. Z. Patenaude, 2668 Park Ave., contemplates erecting a residence on St. Catherine Rd.

L. N. Messier, 489 Mount Royal Ave., plans erection of apt. house.

**Point Grey, B.C.**

H. A. Calladine, Kerrisdale P.O., Point Grey, is erecting a residence on 37th Ave. W.

J. Brown, 1511 65th Ave. W., Point Grey, is erecting a residence costing $7,000.

Stanley Collinge, architect, 318 Standard Bank Bldg., is preparing plans for residence to cost $9,000.

**Quebec, Que.**

Eug. Lamontagne, 1st and Lamontagne Aves., is erecting a residence at cost of $7,800.

**St. Louis de Courville, Que.**

J. L. Corriveau, St. Louis de Courville, will erect a residence.

**Sandwich, Ont.**

A. J. Walker, 50½ London St., plans erection of residence at cost of $8,000.

**Saskatoon, Sask.**

Jos. E. Coombes, 403 Ave. H. S., Saskatoon, contemplates erection of apt. block on Main St.

A. A. Pinder, Temperance St., is erecting a residence.

**Toronto, Ont.**

E. Leake, 1207 Bloor St. W., will receive tenders for all trades required for erection of duplex residence.

W. C. Lock, 101 Glenmore Rd., will receive tenders for all sub trades required for 1 pair residences to cost $10,000.

Wm. McKenzie, Lansing P.O., is erecting a residence costing $5,000 on Doris Ave.

Argent & Banks, 29 St. Marks St., are building 2 residences costing $6,500 each.

G. W. Kucas, 98 Bathgate Ave., is erecting an apt. house costing $20,000.

W. C. Lock, 101 Glenmore Rd., will receive tenders for sub trades for 1 pair and 2 duplex residences on Belhaven Ave.

Miller Bros., 324 Lauder Ave., are building a duplex residence costing $15,000. D. H. Burnham, architect, 260 Lauder Ave.

R. A. Vurry, 1044 Shaw St., is erecting a residence costing $5,500.

Bungalow costing $6,500 is being erected by J. W. Schofield, 745 Keele St.

H. E. Taylor, 41 Harvie Ave., is erecting 1 pair residences on Gertrude Ave.

Wm. Edmonds, 160 Pinewood Ave., is building a bungalow at cost of $7,500.

W. Hughes, 50 Crang Ave., is erecting 2 bungalows costing $5,000 each.

W. Fuller, 120 Mortley Ave., is erecting a residence at cost of $10,000 on Small St.

Superior Homes, Ltd., 1804 Royal Bank Bldg., are erecting 2 pair residences on Cannon Ave.

Jos. Anderson, 66 Linsmore Cres., is building 2 residences costing $5,000 each.

Plans are prepared for 3 residences to cost $5,500 each for Herbert Rose, 502 Rushton Rd.

Herbert Rose, 502 Rushton Rd., will erect 10 residences costing $5,500 each on Atlas and Mulberry Sts.

Residence costing $6,000 is being erected by W. Langlois, 100 McRoberts Ave.

S. E. Pearcy, 1670 Danforth Ave., is building 2 residences costing $5,000 each.

W. H. Kerwin, 38 Beck Ave., is building 15 bungalows at cost of $7,000 each on Strathmore Blvd

W. H. Kerwin, 38 Beck Ave., is erecting a residence at cost of $7,000 on Keystone Ave.

Residence costing $5,000 is being erected by F. Martin, 1392 Queen St. E.

Geo. Drury, 54 Iona Ave., is building a residence at cost of $10,000 on Beck Ave.

G. H. Anderson, 37 Mountview Ave., is building a residence and garage costing $15,000 on Indian Grove.

J. E. Carlisle, 195 Pinewood Rd., is building a residence at cost of $15,000 on Forest Hill Rd.

C. Watkins, 44 Moberley Ave., is erecting 1 pair residences costing $8,000 each.

**Verdun, Que.**

E. L. Descheneaux, 1366 Evelyn St., plans erection of residence.

**Ville St. Laurent, Que.**

Lionel Goyer, 17 Monkland Blvd., is erecting a residence at cost of $9,000.

**Welland, Ont.**

Wm. Manners, Welland, is erecting a residence costing $5,000.

**Windsor, Ont.**

J. Schwartz, 426 Wyandotte St. E., will erect a residence at cost of $9,000 on Victoria Ave.

Residence is being erected on Elesmere Ave. by W. Darville, 1126 Niagara St.

W. Poirier, 1412 Pierre Ave., is erecting a residence costing $4,000.

## CONTRACTS AWARDED

**Chicoutimi, Que.**

Electrical, painting and tile contracts for residence costing $50,000 for Louis Gagnon, Seminaire Rd., are awarded to Gilbert & Frere, Eug. Fortier, Chicoutimi, and Ignace Bilodeau, Ltd., 144 Renaud Ave., Quebec.

**Dundas, Ont.**

Haskins & Minors, Dundas, have general contract for erection of residence and garage costing $10,000 for A. N. Hill, King St.

**Edson, Alta.**

Arthur Weare, Edson, is building 2 residences for D. M. McKenzie, Edson.

**Halifax, N.S.**

Plumbing, heating, electrical and painting contracts for residence costing $7,000 for J. W. Keddy, 130 Cunard St., are awarded to G. B. Murphy, 68½ Cornwallis St.; Longards, Ltd., 215 Hollis St.; W. F. Spruib, 58 Cornwallis St., and David Roche, 238 Argyle St.

Nova Scotia Realty Co., Sackville and Granville Sts., have general contract for erection of residence for R. B. Zinck.

Ford & Lewis, 363 North St., are building a residence for L. T. Donovan, care of builder.

Electrical and plumbing contracts for residence for A. J. Haliburton, 20 Prince St., are awarded to Murray & Stevens, 253 Creighton St., and W. S. Craig, Upper Water St.

General contract for erection of residence for E. L. Stailing, 65 Henry St., is awarded to Musgrave Construction Co., 59 Granville St.

H. S. Goudge, 6 Edinburgh St., has electrical contract for residence for Jos. Egan.

**Kitchener, Ont.**

Plumbing, heating and electrical contracts for residence costing $7,000 for W. H. Dunker, 58 Louisa St., are awarded to Wm. Knell, King St. W.; Ruppel, Neeb & Co., King St. W., and Doerr Electric Co., King St. W.

**London, Ont.**

Masonry and painting contracts for 2 residences for Thos. Janes, 11 High St., are awarded to Oliver Martin, 324 Emery St., and E. J. Clarke, 353 Wortley Rd.

S. Jones, Tecumseh Ave., has carpentry contract for residence for Charles Thomas. 496 Grey St.

**Meteghan, N.S.**

Jos. Thibodeau, Metechan Centre, has general contract for erection of residence for Raymond V. Comeau.

**Mimico, Ont.**

R. Herod & Sons have masonry contract for residence for W. J. McClintock, Central Ave.

G. Sayce, Mimico, has masonry contract for residence for A. E. Brunne, Mimico.

**Moncton, N.B.**

C. C. Lea, 51 Wesley St., will erect a residence costing $9,000 and awarded general contract to J. M. McDougall, care of owner.

**Montreal, Que.**

Eug. Noel, 2140 Rosmount Blvd., is building a residence costing $6,500 for S. Joly, 598 6th Ave.

**Ottawa, Ont.**

Plumbing and heating contracts for residence costing $5,000 for R. F. Mahoney, 222 Florence St., are awarded to Thos. Watters, 94 Bell St.

Harry Hayley, 171 Waller St., has contract for Dolimite faced cast stone required for Parish residence costing $30,000 for St. Anne's Parish.

**Outremont, Que.**

I. Durand, 115-A St. Andre St., has

roofing, plumbing and heating contracts for cottage costing $7,000 for Jos. Meilleur, 157 Plessis St. E. Girard, care of owner, is awarded brickwork contract.

Traversy, Ltd., 100-B Papineau Ave., have contract for sash and doors required for cottage costing $9,000 for E. H. Fox, 460 Wiseman Ave.

**Point Grey, B.C.**

General contract for erection of residence costing $7,800 for L. F. Pearce, 1110 Melville St., Point Grey, is awarded to Robert McCoubrey, 4024 Gladstone Ave. Plumbing and heating contracts are placed with Orr Bros., 1210 Granville St., Vancouver.

Contracts for residence costing $12,790 for Herbert Wallace, Wallace Shipyards, North Vancouver, B.C., are: Millwork, Arbuthnot Lumber Co., 101 Dufferin St. W.; electrical, E. L. McMillan, 2686 42nd Ave.; plumbing and heating, Barr & Anderson, 1060 Homer St.

J. K. Sinclair, 517 11th Ave. E., Vancouver, has general contract for erection of residence costing $10,000 for Dr. G. E. Gillies, Kensington Place, 1386 Nicola St., Vancouver.

Plumbing and heating contracts for residence costing $10,400 for E. W. Lamphrey, Cambie and Hastings St., Vancouver, are awarded to Berbard Boe & Co., Ltd., 132 Cordova St., Vancouver.

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W. R. Kirkpatrick
*Canadian Secretary*

UNITED STATES FIDELITY & GUARANTY COMPANY

**Sandwich, Ont.**

I. C. Green, Randolph St., is awarded general contract for erection of duplex residence costing $15,000 for Albert Reaume, Brighton Beach Hotel.

**Toronto, Ont.**

Plumbing contract for residence for A. & F. Fisher, 114 Church St., is awarded to W. J. Stratton, 314 Lee Ave.

Roofing and plastering contracts for apt. house costing $15,000 for Fred Rielly, 743 Dovercourt Rd., are awarded to Woods Bros., 744 Dovercourt Rd., and G. Smallbeck, 59 Barber Ave.

Additional contracts for 3 pair residences for G. L. Nightscales, 1880 Queen E., are: Electrical, Mead & Co., 244 Silverbirch Ave.; plumbing, L. Hollows, 1564 Danforth Ave.; heating, Howard Furnace Co., 881 Yonge St.; plastering, G. T. Pritchard, 98 Dawes Rd.; painting, A. J. Rance, 98 Hiawatha Rd.

J. Clare, 158 King Edward Ave., has masonry contract for 2 pair residences for W. Greenwood, 74 Rosecheath Ave.

Arnot Bailey, 33 Norton St., has general contract for erection of 2 bungalows costing $6,500 each for Bailey Bros., 33 Norton St.

Geo. Drury, 54 Iona Ave., is erecting 2 pair residences and awarded the following contracts: Electrical, Taylor Bros., 25½ Norwood Rd.; plumbing, J. L. Bloomer & Co., 6 Juniper Ave.; heating, Toronto Furnace & Crematory Co., Ltd., 111 King E.; plastering, T. Nicholas, 63 Chester Ave.

J. Elliott, 98 Concord Ave., has plumbing contract for residential development costing $100,00 for J. T. & H. Hutson, 43 Victoria St.

**Verdun, Que.**

Perrier & Freres, 202 Strathmore St., Verdun, have plumbing and heating contracts for residence costing $7,000 for H. Decarie, 135 Gordon Ave.

Plastering, roofing and brickwork contracts for residence costing $7,500 for E. L. Descheneaux, 1366 Evelyn St., are awarded to A. Brisebois, 112 Dumas St.; H. Potvin, 816 Centre St., and A. Remy, 1313 Gertrude St.

**Ville St. Laurent, Que.**

E. Lepage, 990 Parthenais St., has tiling contract for cottage costing $8,000 for L. Carta, 12 St. Germain Blvd.

**Westmount, Que.**

Jos. St. Amand, 109 Laurier W., has roofing, plumbing and heating contracts for apt. house for L. Carta, 12 St. Germain Blvd. Contract for sash and doors is placed with H. Langevin, Cartierville, Que.

**Windsor, Ont.**

Frank Pickells, 1451 Dougall Ave., has general contract for erection of residence costing $5,000 on York St. for J. Williams.

## Power Plants, Electricity and Telephones

**Annapolis Royal, N.S.**

J. G. Johnston, architect, Kentville, N.S., is preparing plans for telephone exchange for Maritime Telegraph & Telephone Co., Ltd., Hollis St., Halifax

**Cayuga, Ont.**

Town Council contemplate Hydro system. R. S. Colter, clerk.

**Palmerston, Ont.**

Town Council plan improvements to electric lighting system to cost $6,000. H. Hyndman, clerk.

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A few dollars spent in advertising your proposals in

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·BULLETIN ·Nº 5·

# ·BURLINGTON·STEEL·Cº·LTD·

RAIL CARBON — REAL STRENGTH

## ·HAMILTON·ONT·

## ·AUTOMATIC · PROTECTION·

IF YOU DROP A PIECE OF TOOL STEEL ON THE FACTORY FLOOR IT WILL PROBABLY BREAK BUT THIS DOES NOT CONDEMN THE USE OF TOOL STEEL.

IF YOU BEND A RAIL-CARBON BAR WITH A JERK IT IS LIABLE TO BREAK, BUT NEITHER DOES THIS CONDEMN THE BAR.

THE ELASTIC LIMIT OF A MILD STEEL BAR IS AROUND 33,000 lbs. per sq. inch. THE ELASTIC LIMIT OF A RAIL-CARBON BAR IS WELL OVER 50,000 lbs. per sq. inch OR AN INCREASE OF 50%.

SOME ENGINEERS WILL TELL YOU THEY HAVE SEEN RAIL-CARBON BARS ACCIDENTLY DROPPED AND BROKEN IN TWO

DOMINION PARLIAMENT BUILDING OTTAWA
RAIL CARBON STEEL BARS USED FOR REINFORCING CONCRETE

DID YOU EVER CONSIDER WHAT WOULD HAPPEN TO A MILD STEEL BAR IF DROPPED UNDER SIMILAR CONDITIONS?

THE BLOW WHICH BREAKS THE RAIL-CARBON BAR WOULD STRESS THE MILD STEEL BAR AWAY BEYOND ITS ELASTIC LIMIT, THE METAL WOULD BE PERMANENTLY STRAINED BUT YOU DON'T KNOW IT AND YOUR INSPECTOR CAN'T FIND IT OUT.

BENDING IN THE FIELD IS MOST COMMONLY DONE BY UNSKILLED LABOR.

UNSKILLED LABOR RARELY REALIZES THAT ANY AND EVERY BAR MUST BE BENT AROUND THE MANDRIL SLOWLY IN ORDER TO ALLOW THE METAL TO "FLOW."

THE WORD YANK IS NOT DEFINED IN WEBSTER'S DICTIONARY BUT IT MIGHT VERY TRULY BE DEFINED AS "THE PREVAILING METHOD, EMPLOYED BY UNSKILLED LABOR IN BENDING REINFORCING BARS."

UNDER THE "YANK" METHOD, THE MILD STEEL BAR IS PERMANENTLY STRAINED AND IS SO EMBODIED IN THE STRUCTURE,— THE HOOK AT THE END OF YOUR RODS IS RENDERED USELESS.

UNDER THE "YANK" METHOD THE RAIL-CARBON BAR BREAKS AND IS THROWN OUT, - AND YOUR CONTRACTOR SOON SEES TO IT THAT THE "YANKING" STOPS.

WHICH DO YOU PREFER:

**AUTOMATIC PROTECTION OR CONCEALED DEFECTS?**

WE HAVE EVERY MODERN FACILITY AT OUR PLANT FOR BENDING TO YOUR SCHEDULE AND PREFER TO SHIP THE BARS TO YOU CUT TO LENGTH, TAGGED AND BENT READY TO DROP INTO THE FORMS.

WE PRIDE OURSELVES ON FAST AND ACCURATE DELIVERIES.

WHY NOT TRY US OUT?

·BULLETIN ·Nº 6 - THE ·SPECIFICATION·

# Current Prices of Building and Engineering Materials

| CEMENT (Delivered on job):— | | Toronto | Montreal. | Winnipeg. | Vancouver |
|---|---|---|---|---|---|
| Retail lots, including bags | per bbl | $4.50 | $4.76 | $4.80 | $3.70 |
| Car lots, including bags | per bbl. | 3.90 | 3.92 | 4.16† | 3.35 |
| Refund on bags | each | .20 | .20 | .20 | |
| **LIME (Delivered on job):—** | | | | | |
| Lump, in retail lots | per ton | 14.00 | 14.00 | .58 bu. | 2.70 bbl. |
| Lump, in car lots | per ton | 12.40** | 11.00 | 13.80 ton* | 2.60 bbl |
| Hydrated, in retail lots | per ton. | 19.25 | 26.00 | .60 bag* | 30.00 |
| Hydrated, in car lots | per ton. | 18.00 | 21.00 | .54 bag*† | 25.00 |
| **BRICK and TILE (Delivered on job):—** | | | | | |
| Common face brick | per M. | 24.00 | 16.00* | 20.00 | 30.00 |
| No. 1 dry pressed brick | per M. | 30.00 | 27.00 | 42.00 | 70.00 |
| No. 2 dry pressed brick | per M. | 28.00 | 23.00 | 40.00 | |
| Enamelled brick | per M. | 150.00 | up to 230.00 | 205.00 | 150.00 |
| Wire cut brick, for foundation work | per M. | 18.00 | 19.25 | | 50.00 |
| Hollow building tile | per M. | | 8¼-29c.per ft. | 21-32c per ft. | 105-240.00 |
| Paving brick, imported | per M. | on appl. | 100.00 | 65.00 | 60.00 |
| Fire brick | per M. | 65-95 | 60-110.00 | 85-100 | 80.00 |
| Fire clay | per ton | 17.22 | 15- 20.00 | 35.00** | 22.00 |
| **STONE, SAND and GRAVEL (f.o.b. cars on siding):—** | | | | | |
| Crushed stone, 2 in. | per ton | 2.03¼ | 2.00 | 2.85 yd.* | $2.00 yd. |
| Crushed stone, 1 in. and under | per ton | 2.29 | 2.10 | 3.25 " | " " |
| Crusher run | per ton | 2.18¾ | | 2.95 " | " " |
| Rubble stone | per ton | 2.45 | 1.80 | 15.00 cord | " " |
| Gravel, 2 in. screened | per ton | 2.03¼ | | 2.85 yd. | " " |
| Gravel, 1 in. screened | per ton | 2.29 | 1.50 | 3.25 " | " " |
| Sand, screened | per ton | 1.41½ | 1.25 | 1.90 " | " " |
| Pit run | per ton | 1.51½ | 1.25 | 1.90 " | " " |
| **STEEL and IRON (f.o.b. warehouse):—** | | | | | |
| Mild steel bars, ¼ in. and heavier | per 100 lbs. | 3.00 base | 2.75 base | 5.45-5.90 | $4.00 |
| Bands 3/16 in. and lighter | per 100 lbs. | 3.50 " | 3.00 " | 5.45 | |
| Hoops | per 100 lbs. | 3.75 " | 3.00 " | | |
| Twisted and deformed bars | per 100 lbs. | 3.00 " | 2.75 " | 5.80 | 4.00 |
| Angles, channels and tees under 3 in. | per 100 lbs. | 3.10 " | 3.75 " | 7.00 | 6.00 |
| Structural shapes | per 100 lbs. | 3.40 net | 4.00 " | 6.75 | 6.00 |
| Plates—¼ in. and heavier | per 100 lbs. | 3.25 base | 3.75 " | 5.70 | 6.25 |
| Plates—3/16 in. | per 100 lbs. | 3.75 | 4.25 " | 5.70 | 6.50 |
| Plates—10 gauge | per 100 lbs. | 3.95 base | 4.40 " | 5.70 | 6.50 |
| Black sheets—28 gauge | per 100 lbs. | 4.50 " | 5.00 " | 6.05 | 8.25 |
| Galvanized sheets—28 gauge | per 100 lbs. | 6.00 " | 6.35 " | 10.25 | 9.35 |
| Galvanized Corrugated sheets—28 gauge | per 100 ft. | 6.50 | 6.50 | 8.30 | 8.25-8.50 |
| Rivets | per 100 lbs. | 6.00 base | 6.50 base | | |
| Cast iron pipe | per ton. | 60.00 | 60.00 | | |
| **VITRIFIED CLAY PRODUCTS (Delivered on job):—** | | | | | |
| Sewer pipe, 4 in. | per ft. | .40 | .30 | .35 | .28 |
| Sewer pipe, 6 in. | per ft | .60 | .45 | .45 | .48 |
| Sewer Pipe 8 in. | per ft. | .80 | .70 | .60 | .55 |
| Sewer Pipe 9 in. | per ft. | 1.00 | .85 | .70 | .60 |
| Sewer Pipe 10 in. | per ft. | 1.20 | 1.05 | .80 | .70 |
| Sewer Pipe 12 in. | per ft. | 1.50 | 1.35 | 1.00 | .85 |
| Sewer pipe, 15 in. | per ft. | 2.25 | 1.80 | 1.85 | .95 |
| Sewer pipe, 18 in. | per ft. | 3.00 | 2.50 | 2.45 | 1.50 |
| Sewer pipe, 21 in. | per ft. | 4.00 | 3.00 | | 1.90 |
| Sewer pipe, 24 in. | per ft. | 5.00 | 4.50 | 3.75 | 3.10 |
| Tile wall coping, 8 or 9 in. | per ft. | .60 | .50 | | .50 |
| Tile wall coping, 12 or 13 in. | per ft. | .90 | .75 | | .60 |
| Flue lining, 8½ x 8½ in. | per ft. | .70 | .60 | .55 | .40 |
| Flue lining, 8½ x 13 in. | per ft. | 1.00 | .90 | .75 | .75 |
| Chimney tops | each | 9.00 | 3.50-5.00 | 7.50 | 4.50-6.00 |
| Discounts | | 40% truck lots<br>40 & 15% car lots | 20%<br>50% | 5% | |

**CEMENT**:—*Discount of 10 cts. per bbl. in 30 days. Price f.o.b. cars is $4.05 †Subject to 5% discount. **Excluding bags.

**LIME**:—*Discount of 5%. †Bag of 50 lbs. **Price f.o.b. cars is $11.40.

**BRICK AND TILE**—*f.o.b. plant.

**STONE, SAND AND GRAVEL**:—*Winnipeg prices subject to 5% discount.

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## BECKWITH PATENTS

### *A Material Hustler*

It backs or moves up under its own power, easily placing heavy loads in exact position. Does it, too, in less time and with only half the gang ordinarily required

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Crawler, road-wheel or rail-truck mounting adapts the Auto-Crane for any footing. Gasoline, steam or electric operation permits the use of convenient fuel

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## CURRENT PRICES OF BUILDING AND ENGINEERING MATERIALS—continued

| LUMBER (Delivered on job):— | | Toronto. | Montreal. | Winnipeg. | Vancouver.* |
|---|---|---|---|---|---|
| Flooring, 1 x 3 and 4 in., clear, E. G. fir | per M. | 80.00 | 90.00 | 77.50 | 55.00 |
| Flooring, 1 x 3 and 4 in., clear, F. G. fir | per M. | 60.00 | 77.50 | 59.50 | 30.00 |
| Flooring, No. 1 pine | per M. | 70.00 | 100.00 | 77.50 | |
| Flooring, No. 1 Spruce | per M. | 52.00 | | 51.00 | |
| Flooring, birch and maple, 13/16 in. clear | per M. | 130.00 | 160.00 | 193.00 | 200.00 |
| Flooring, plain red oak, ⅞ in. clear | per M. | 140.00 | 240.00 | 153.00 | 265.00 |
| V joint, 1 x 3 and 4 in., Nos. 1 and 2, clear, fir | per M. | 60.00 | 77.50 | 59.50 | 30.00 |
| V joint, No. 1 pine | per M. | 70.00 | 100.00 | 76.50 | |
| Pine, 1 x 4 to 12 in., common rough | per M. | 43-58 | 120.00 | 76.50 | |
| Pine, 2 x 4 to 12 in., common rough | per M. | 51-63.00 | 120.00 | 38.00 | |
| Hemlock, 2 x 4 to 12 in. | per M. | 40-42.00 | 55.00 | 41.00 | 11.50-18.75 |
| Fir, 1 x 4 to 12 in. No. 1 common, D 1 S | per M. | 40-50.00 | 60.00 | 41.00 | 11.00-13.50 |
| Spruce, 1 and 2 x 4 to 12 in. | per M. | 48-58 | 55-65.00 | 38.00 | |
| Timbers, fir, 10 x 10 in. and up | per M. | 60.00 | 75-100.00 | 48.50 | base 17.- 22.00 |
| Lath, No. 1 white pine | per M. | 14.00 | 16.00 | 10.20 | |
| Lath, M. R. spruce | per M. | 10.00 | 10.00 | 8.50 | 7.00 |
| Shingles, XXX B.C. cedar | per M. | 6.50 | 7.50 | 5.00 | 3.40 |
| XX B.C. cedar | per M. | 4.75 | 6.50 | 5.00 | 1.90 |
| N.B. extras | per M. | 10.50 | 7.00 | | |
| N.B. clears | per M. | 9.50 | 6.25 | | |
| Pine casing | per M. | 1 ct. per in. | 120.00 | 85.00 | |
| Fir casing | per M. | 1 ct. per in. | 125.00 | 80.00 | 55.00 |
| **PAINTS, OILS, COLOURS (delivered):—** | | | | | |
| White lead ground in oil, less than ton lots | per cwt. | 13.55 | 13.10 | 14.35 | 15.80 |
| Red lead, dry, small lots | per cwt. | 20.00 | 9.55 | 20.00 | 22.00 |
| Putty in bulk | per cwt. | 6.70 | 4.75 | 5.50 | 9.25 |
| Steel sash putty in bulk | per cwt. | 7.20 | 6.00 | 9.00 | 7.75 |
| Boiled linseed oil, in bbls. | per gal. | .87 | .87 | 1.08 | 1.28 |
| Raw linseed oil, in bbls. | per gal. | .84 | .85 | 1.05 | 1.25 |
| Turpentine, in bbls. | per gal. | 1.20 | | 1.30 | 1.60 |
| Mortar Color, maroon, in bbls. | per lb. | .02¼ | | .05¾ | 6.45 per cwt |
| Mortar Color, black, in bbls. | per lb. | .08½ | | .05¾ | .45 |
| **PLASTER (Delivered):—** | | | | | |
| Hard wall plaster, sanded | per ton | 14.00 | 15.00 | 24.50 | 30.00 |
| Plaster of paris, in bbl. lots | per bbl. | 6.00 | 5.60 | 1.70 bag* | 7.50 |
| Plasterers' hair | per bag | 2.50 | 7½ cts. per lb. | 1.00 bu | 1.50 |
| **LABOR:—** | | | | | |
| Bricklayers | per hr. | 1.00 | .80-.90 | 1.15 | 1.06¼ |
| Structural Iron Workers | per hr. | .85 | .50-.75 | 1.25 | 1.00 |
| Plasterers | per hr. | 1.00 | .70-.80 | 1.05 | 1.06¼ |
| Hoisting Engineers | per hr. | .70-.80 | .40-.50 | .90-1.10 | 1.00 |
| Plumbers | per hr. | .90 | .60-.75 | 1.00 | .90 |
| Carpenters | per hr. | .80 | .50-.65 | .90 | .81¼ |
| Painters | per hr. | .75 | .55-.65 | .80 | .81¼ |
| Electrical Workers | per hr. | .87½ | .65 | .70- .90 | 1.00 |
| Roofers | per hr. | .65 | .65 | | .90 |
| Laborers | per hr. | .40-.50 | .25-.40 | 47½-.55 | .50-.56¼ |
| Sheet Metal Workers | | | | | .90 |

**LUMBER:**—*Owing to the general unstable condition of the present lumber market, Vancouver dealers refuse to quote any prices at all, especially for Prairie or Eastern publication. The prices are, moreover, fluctuating from day to day. Such prices as we quote are, therefore, averages and not standard.

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We equip complete plants for making cement tile, brick block, sewer pipe etc.

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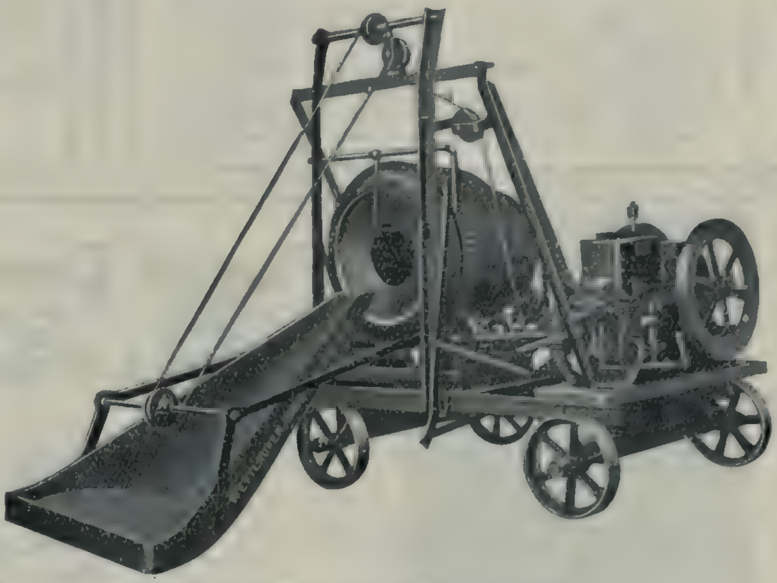

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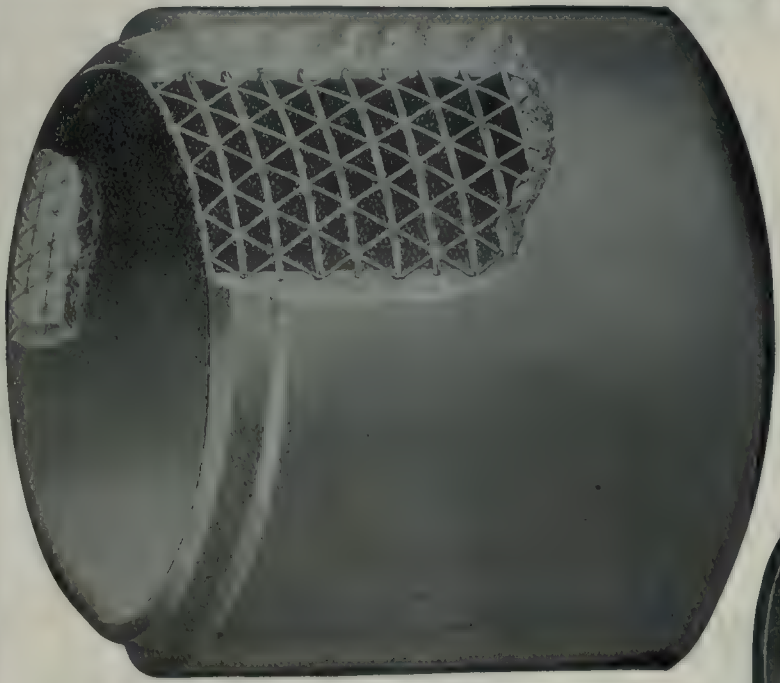

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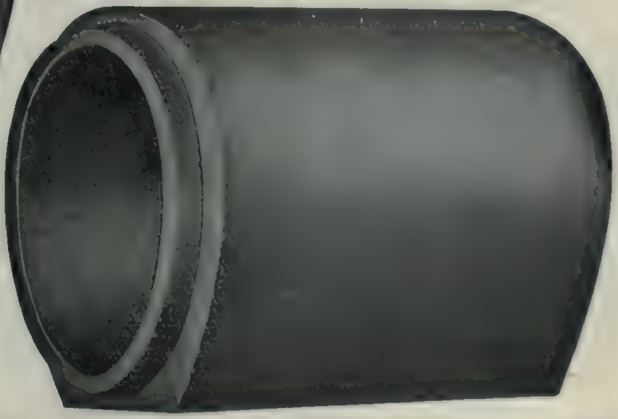

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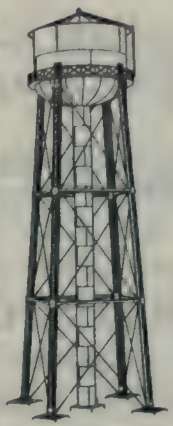

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$\frac{5}{8}$-in., $\frac{3}{4}$-in. and 1 in.

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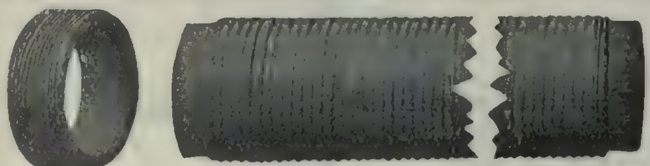

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from 2 in. to 24 in. diameter

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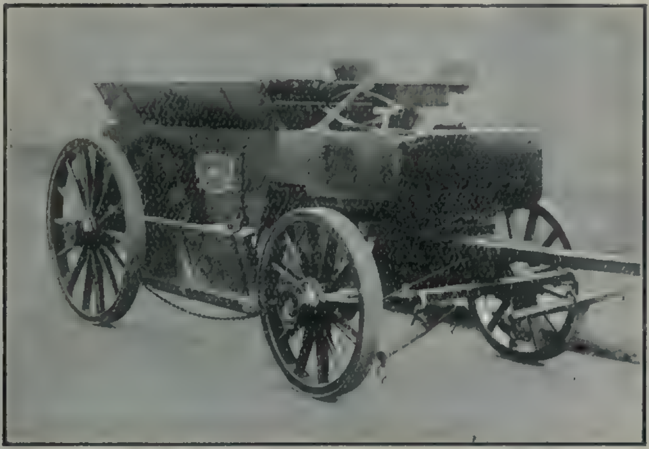

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***Two Yard Capacity (Water Level)***
***BUILT FOR SERVICE***

The body of the "Ottawa" Dump Wagon is made of selected air-dried Hard Maple 1¾″ thick, strongly braced with angle irons at corners, well bolted.

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**Height of front wheel 3′.**
**Height of rear wheel 4′.**
**Wheels equipped with ⅝″ x 4″ steel tires rounded edges.**
**Spokes and rims of selected white oak.**
**The doors have a clearance of 12″ when dumping.**

Standard equipment with each wagon consists of doubletrees, singletrees, ring, neckyoke and wheel wrench.

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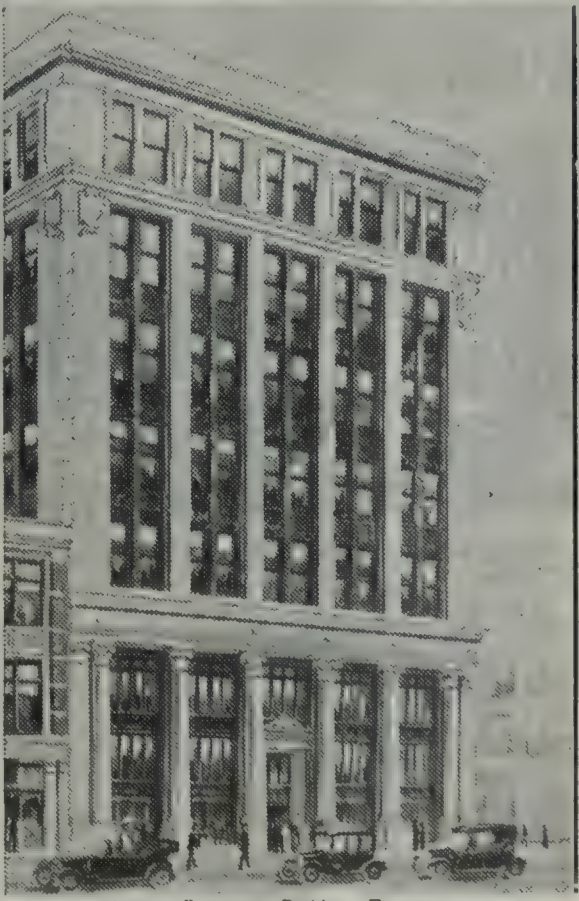

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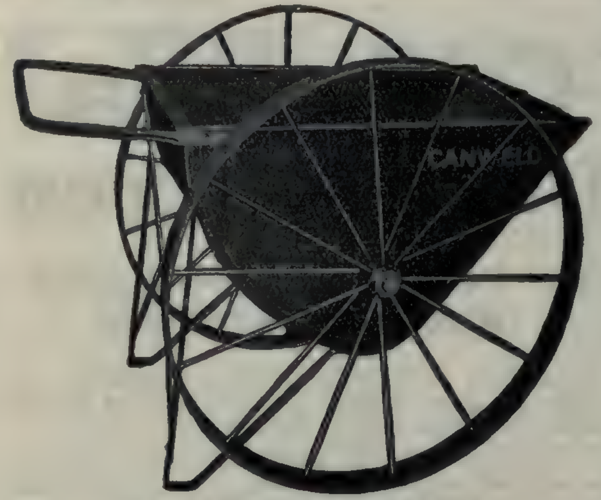

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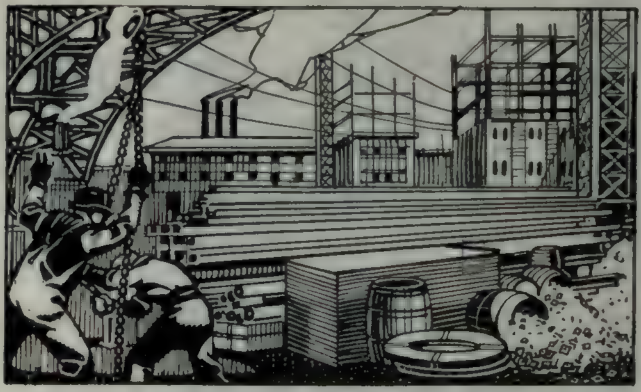

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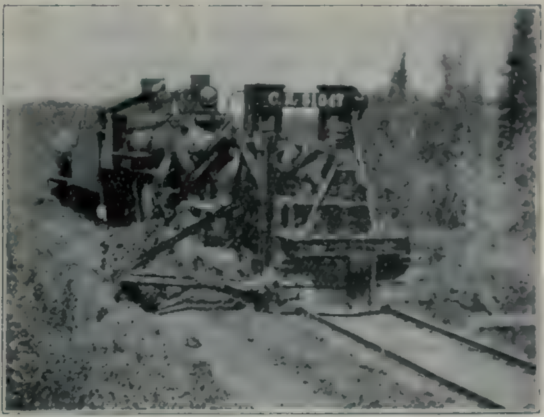

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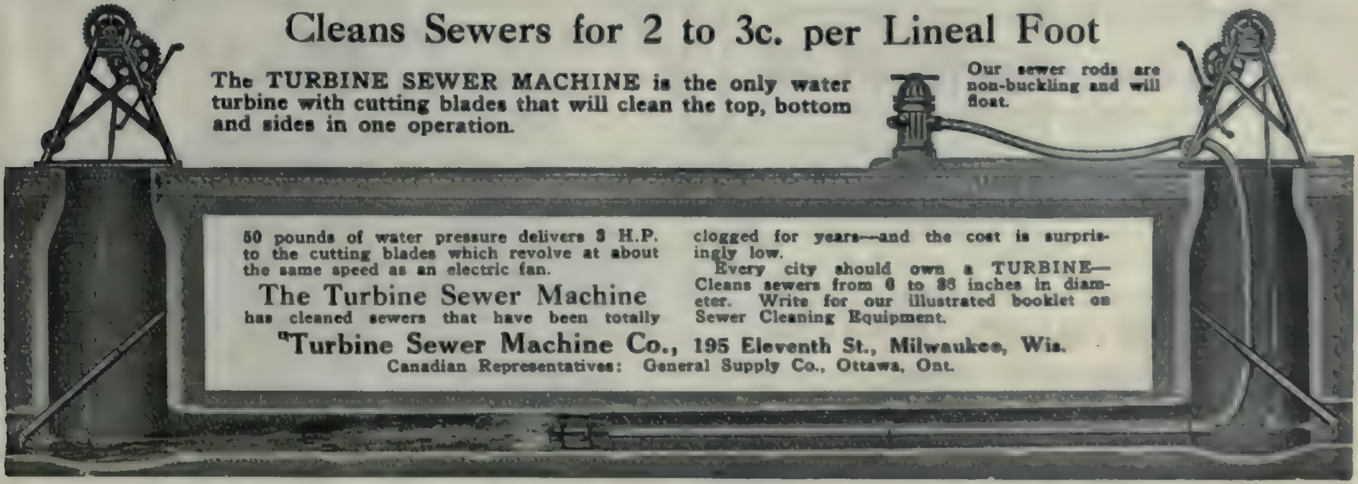

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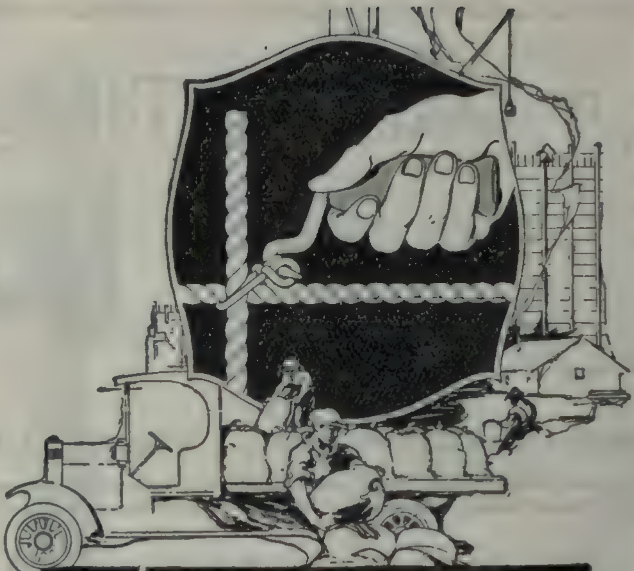

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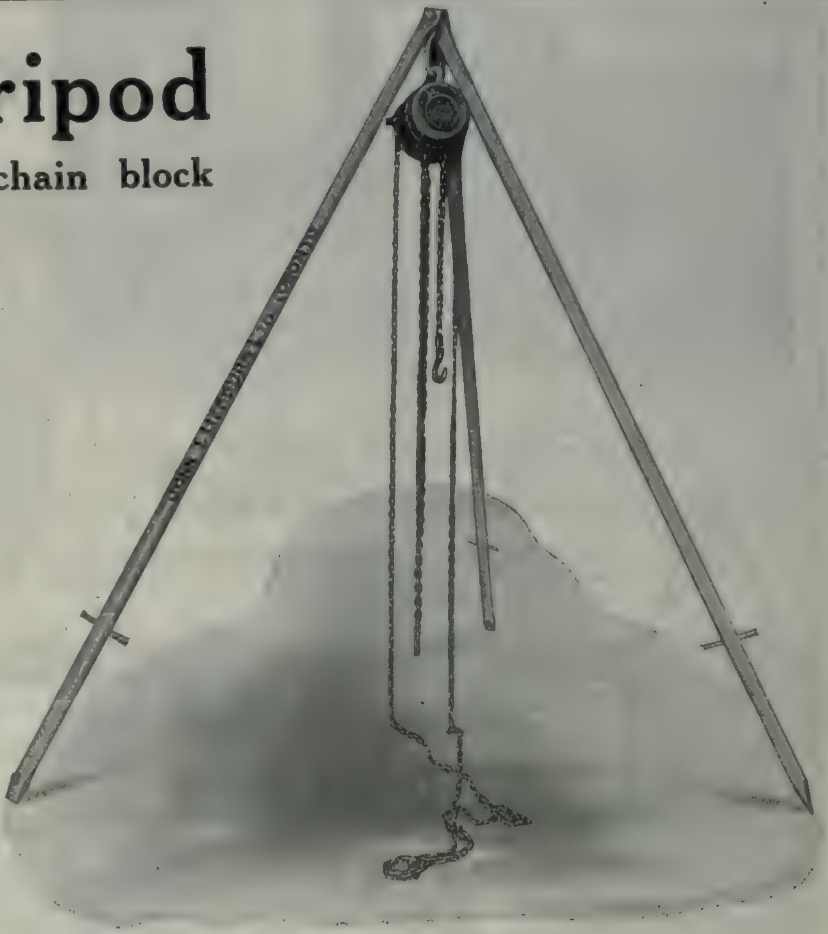

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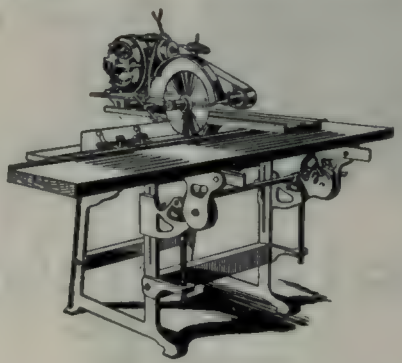

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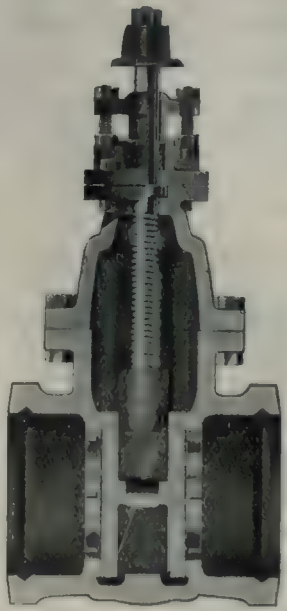

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such work. Therefore, contingent overhead should be estimated for each particular operation.

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While society is gradually shaping our affairs to increase the general overhead by requiring better equipped and more talented organizations in order to produce better structures, increasing taxes on capital invested and incomes, increasing contingent overhead by the introduction of workmen's compensation laws, requiring surety bonds, etc.; is the engineering profession giving due consideration to this item of cost "construction overhead?" Those of us who are devoting our energies mainly to construction work or general contracting often realize its overwhelming power too late, still following the old school methods of preparing estimates, which were in vogue when overhead was a very small factor in costs.

In conclusion, the endeavor has been to leave this one thought with you; that overhead costs are necessary and essential in our present day methods of carrying on construction work, and should be given the same consideration and looked upon in the same light as other legitimate costs entering into the grand total of expense for doing the work.

## Mainly Constructional

**East and West—From Coast to Coast**

The City Council at Verdun, P. Q., recently approved of a by-law authorizing the borrowing of $50,000 for improvements to the local water works and fire systems.

The C. P. R. shops at Angus, P. Q., are at present closed down for a short period, owing to lack of work. The company's passenger coaches are manufactured here, a staff of 5,000 men being employed in normal times.

Messrs. Yolles and Rotenberg, Limited, contractors, of Toronto, contemplate, it is reported, the erection of a ten-storey office building at the corner of Richmond and Sheppard Streets.

The C. P. R. shops at North Bay have also closed down until January 4. About 350 men are affected. It has been the custom to close these shops down for a short period at the end of the year, but this year the shops closed on December 15, a longer period than usual.

The directors of the Canadian National Exhibition, at the final meeting held recently in Toronto, approved of the site for the new Pure Food Building. This new building will be erected on the former site of the outdoor machinery display, north of the Grand Stand, and will be ready for next year's fair.

Water was let into the first section of the new Montreal aqueduct recently, increasing the city's supply by 25,000,000 gallons daily. The completed portion of the canal to the Crawford dam now contains 17 ft. of water. The capacity of the present electrically driven pumps is 75,000,000 gallons per day, but should the demand increase in the summer months, the stand-by steam pump can be put into operation and there is sufficient water now available to take care of such an increased demand.

The formal opening of the huge Live Stock Arena at the Exhibition Grounds, Toronto, took place recently, Mayor Church officiating. The opening was featured with an indoor athletic meet, participated in by the school children and athletes of the police and fire departments. The arena proper provides accommodation for 20,000 people, and besides there are several assembly rooms, restaurant accomodations, etc.

The annual meeting of the Master Plumbers' Association, of Montreal, was held recently in that city and the following officers elected for the coming year: president, H. Lavigueur; first vice-president, George Delaney; second vice-president, Jos. A. Francoeur; past president and representative to the board of directors of the Builders' Exchange, D. A. Bethune; hon. secretary, John Watson, executive secretary, D. Trotter.

The Montreal Branch of the Engineering Institute of Canada held its annual meeting at the Institute's quarters on Mansfield St., recently and elected the following new officers for the coming year: Chairman, Mr. J. A. Duchastel; vice-chairman, Mr. John T. Farmer; Executive Committee, Lt.-Col. R. Bickerdike and Messrs. C. J. Desbaillets and P. B. Motley. The chair was occupied by the retiring chairman, Mr. J. H. Hunter. An important decision was reached at the meeting to assess each member for an amount not exceeding $5.00, for the purpose of establishing a reserve fund for the branch.

Contracts for the last two sections of road on the main highway between Fredericton and Woodstock, N. B., have been let to the firms Concrete Builders, Limited, of Fredericton, and Guilford Hammond, of Dumfries. The two contracts are for about 13 miles of road, which will practically complete the Fredericton-Woodstock highway, with the exception of a short section at Meductic, which will be built under the supervision of the Highway Department. This highway, when completed, will have cost about $500,000.

About 8,000 miners of the Dominion Coal Company, at Sydney, N. S., recently received notification that their wages will be reduced approximately one-third at the beginning of the year. It is thought likely that ultimately this reduction will be applied to the entire 12,000 miners employed in the Maritime district, the smaller firms following the lead of the Dominion Coal Company. At this writing no information is available as to the attitude of the men in regard to this wage reduction.

Two resolutions bearing on the unemployment situation in Northern Ontario were passed recently at a meeting of the Unemployment Committee of North Bay. The Ontario Government will be asked to carry out all possible work in connection with the improvements and repairs on the T. and N. O. Railway at this point and along the remainder of the system. The committee also urged the North Bay Town Council to have the right-of-way on the T. and N. O. cut-out along the line of deviation from North Bay to Mileage 35, in order to partake in the Government's offer of aiding in the cost of extra undertakings this winter for the relief of unemployment.

## Personal

Mr. T. Martin, division engineer for the C. P. R. at Revelstoke, B. C., has been transferred to the Nelson Division, at Nelson, B. C.

Mr. W. N. C. Carlton, librarian of the Hamilton Public Library, recently addressed the Hamilton Chapter of the Ontario Association of Architects, on the planning of library buildings.

# CONSTRUCTIONAL ACTIVITY

## Period of December 21 to December 27, 1921

***Dominion Wide Service Exclusive to "Contract Record & Engineering Review"***

## Waterworks, Sewerage and Roadways

**Hamilton, Ont.**
City Council plan construction of watermain on Roxborough Ave. E. R. Gray, Engr.

**London, Ont.**
Utilities Commrs. plan watermain extensions. E. V. Buchanan, Mgr. Commrs.

Construction of concrete highway on Pipe Line Rd. from city limits to Springbank, 4 miles, is contemplated by City and Middlesex County Councils. H. A. Brazier, City Engr., London; Chas. Talbot, County, Engr., County Bldgs., London.

**Montreal, Que.**
City Council plan following works: Water conduit costing $180,000 on Sherbrooke St. E., Delorimier Ave. to C.P.R.; water conduit, $90,000, Aqueduct Canal, Ville Emard; water conduit, $86,000, across canal at Seminary St.; water pipe, Blvd. Cremazie, $80,000; sewer, $76,000, Stuart St., Cremazie to Beaumont; sewer, $75,000, Berman St., Cremazie to Beaumont; $60,000 Sherbrooke St., Des Erables to Wurtele; sewer, $50,000, Lanoraie St., Cremazie to Abraham; sewer, $17,000, Allen St., Ogilvy to Ball St.; $16,000, Moreau St., via Duquette, Ontario St. to Prefontaine; sewer, St. Donat, Marseille to Sherbrooke St.; $14,000, Hochelaga St., Jolicouer to Bourbonniere St.; $14,000, Ontario St., Moreau to South St.; sewer, $8,000, Fullum St., Sherbrooke St. 600 ft. south; $6,000, Elleslie St.; Marseille St.; Broadway West, between Sherbrooke and Millen Sts., $40,000; Oak St., between Broadway West and Patricia, $20,000; Nazarin St., between Jolicoeur and Allard Sts., $39,000; Iberville St., between Belanger and Cote St. Michel, $39,000; Des Ecorres, between Belanger and Cote St. Michel, $39,000; Cadastre St., between Gauthier and East Sts., $20,000; Sherbrooke St. E., between Maisonneuve and St. Jean de Dieu Sts., $235,000; Sherbrooke St. E., between St. Jean de Dieu and Pointe aux Trembles, $398,000.

Tenders will be called shortly for construction of macadam road, Montreal to Sorel, Que., for Prov. Govt., Dept. Pub. Works.

**Ottawa, Ont.**
Construction of concrete road and grading at Experimental Farm is contemplated by Dom. Govt., Dept. Pub. Works.

**Point Grey, B.C.**
Council of Point Grey Municipality, Kerrisdale, Point Grey, B.C., contemplate street and road improvements estimated to cost $'00,000. W. B. Greig, Engr., Point Grey.

**Ridgetown, Ont.**
Question of additional paving will be considered by Council. D. Cochrane, secy.-treas.

**St. Catharines, Ont.**
Construction of pipe line on Niagara St. from city limits to S.S. No. —, is contemplated by Grantham Twp. Council. F. N. Rutherford, Engr., 24 Queen St., St. Catharines.

City Council plan construction of relief sewer at cost of $25,000 on Welland Ave., Ontario and Queen Sts. W. P. Near, Engr.

**Ste. Therese, Que.**
B. Michaud, Deputy Min. Dept. Pub. Works, Prov. Govt., Parliament Bldgs., Quebec, Que., will receive tenders until Jan. 5th for gravelling 22 miles of Road de la Grande Ligne on Montreal-Mont Laurier route. Plans with Engr. No. 3 District.

**Stokes Bay, Ont.**
Eastnor Twp. Council plan improvements in connection with Center Rd. and other roadwork. Malcolm McIver, secy.-treas., Stokes Bay.

**West Lorne, Ont.**
Construction of permanent pavement costing $5,000 is contemplated by Town Council. J. S. Robertson, secy.-treas.

### CONTRACTS AWARDED

**Toronto, Ont.**
Gordon Thompson, 40 Jarvis St., Toronto ,is awarded general contract for construction of 6 in. water mains costing $32,000 for York Twp. Council. Frank Barber & Associates, Ltd., Engrs., 40 Jarvis St., Toronto.

**Victoria, B.C.**
General contract for street grading costing $45,261 on Johnson St., from new bridge to Lime St., for City is placed with Pacific Construction Co., Ltd., 1414 Standard Bank Bldg., Vancouver.

## Railroads, Bridges and Wharves

**Francois Xavier, Man.**
Construction of 2 concrete bridges at cost of $18,000 is contemplated by Municipality of Francois Xavier. C. A. Prefontaine, secy.-treas.

**St. Hughes, Que.**
Town Council plan construction of bridge and abutments. I. Vallee, Engr., Pub. Works Dept., Prov. Govt., Quebec, Que.

### CONTRACTS AWARDED

**Montreal, Que.**
J. A. Desmoreau, 1060-A Berri St., has millwork contract for car cleaning shop costing $50,000 in Glen yards for C. P. Rlys.

## Public Buildings, Churches and Schools

**Aubert Gallion, Que.**
Erection of school is contemplated by School Bd. A. Catelluer, secy-treas., St. Georges, Que.

**Leamington, Ont.**
R. C. Desrochers, secy. Dept. Pub. Works, Ottawa, will receive tenders until Jan. 5th for alterations and addition to interior fittings in Post Office, Leamington. Plans at offices of Chief Arch. Dept., Ottawa; Res. Arch., General P.O., Toronto; Caretaker of Pub. Leamington. Accepted cheque for 10% of tender required.

**Morden, Man.**
Erection of hall at cost of $7,000 is contemplated by Town. G. McCorquodale, secy.-treas.

**Ottawa, Ont.**
Public School Bd. contemplate altering bldg. for school at corner Gilmour and Elgin Sts. Crawford Ross, secy.

**Saanich, B.C.**
Erection of addition to school is planned by Saanich School Bd. Hector Cowper, clerk, Royal Oak, Saanich.

Saanich School Bd. contemplate erection of school.

**St. John, N.B.**
Erection of Sunday School at cost of $30,000 is contemplated by Main St. Baptist Church Congregation. Rev. Dr. David Hutchison, Pastor.

**Scarboro Junction, Ont.**
Erection of high school is contemplated by High School Bd. W. D. Annis, secy-treas., Scarboro Junction.

**Simcoe, Ont.**
Erection of school in North Ward is contemplated by School Bd. Mr. Murdoch, Chrm.

**Welland, Ont.**
Public library is contemplated by City Council. W. E. Forrester, clerk.

**Woburn, Que.**
School Bd. plan erection of school. Z. Breault, secy-treas., Woburn, Que.

### CONTRACTS AWARDED

**Chicoutimi, Que.**
Roofing, plumbing and heating contracts for addition to hospital costing $45,000 for Hotel de St. Vallier are awarded to Cie d'Eclairage et d'Energie Electrique, Ovide Guay, and Edgar Lepine. Eug. N. Fortier has painting contract.

**Montreal, Que.**
Contract for organ for church at corner Bernard and Outremont Sts. for Temple Baptist Church is placed with Cavasant Freres, St. Hyacinthe, Que.

E. Lepage, 990 Parthenais St., has contract for blackboards for school costing $35,000 for R. C. School Cmsn., North District.

**Newtonbrook, Ont.**
Jas. Drury, Willowdale P.O., has general contract for erection of portable school for School Section York East No. 5.

**North Toronto, Ont.**
Contracts for erection of High School costing $160,000 for Bd. of Education, are: Masonry, at $77,486, Witchall & Son, 156 St. Helens Ave.; heating and plumbing, at $39,750, W. J. McGuire, 91 Jarvis St.; carpentry, at $26,280, Hudson & Mosely, 6 Algonquin Ave.; steel, at $5,090, Reid & Brown, 63 Esplanade E.; orn. iron, Shipway Iron & Wire Regulator Co., 82 Chest-

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